AMS Payload Overview

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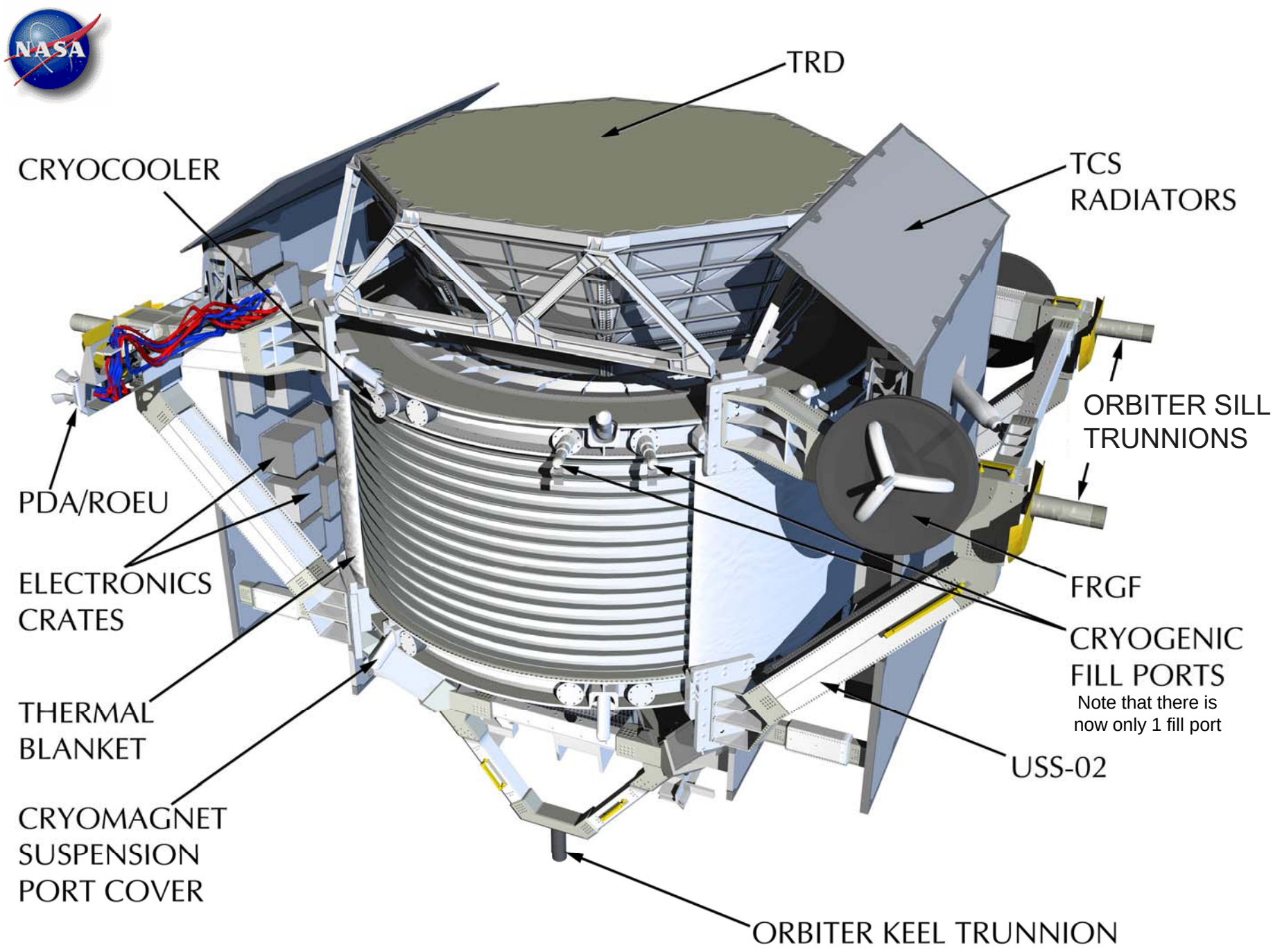
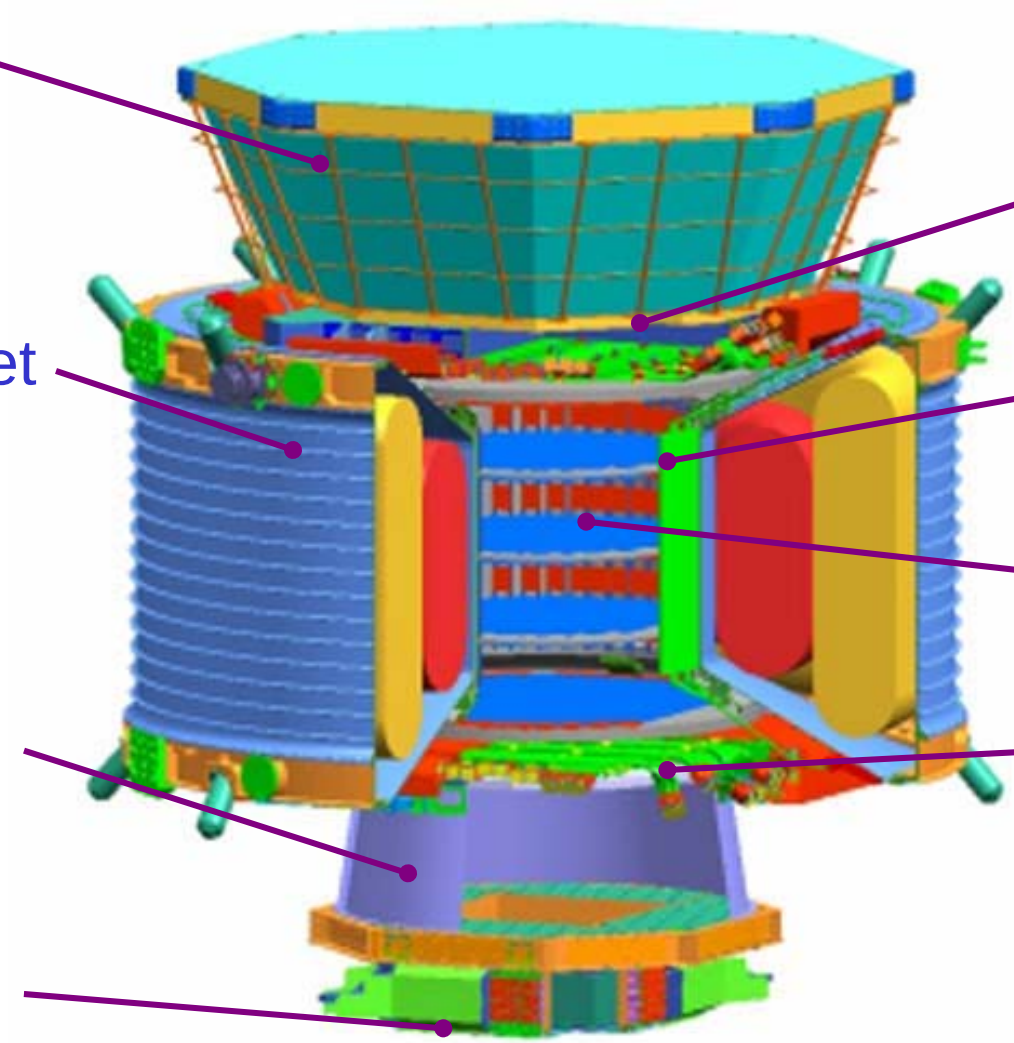
4 August, 2008

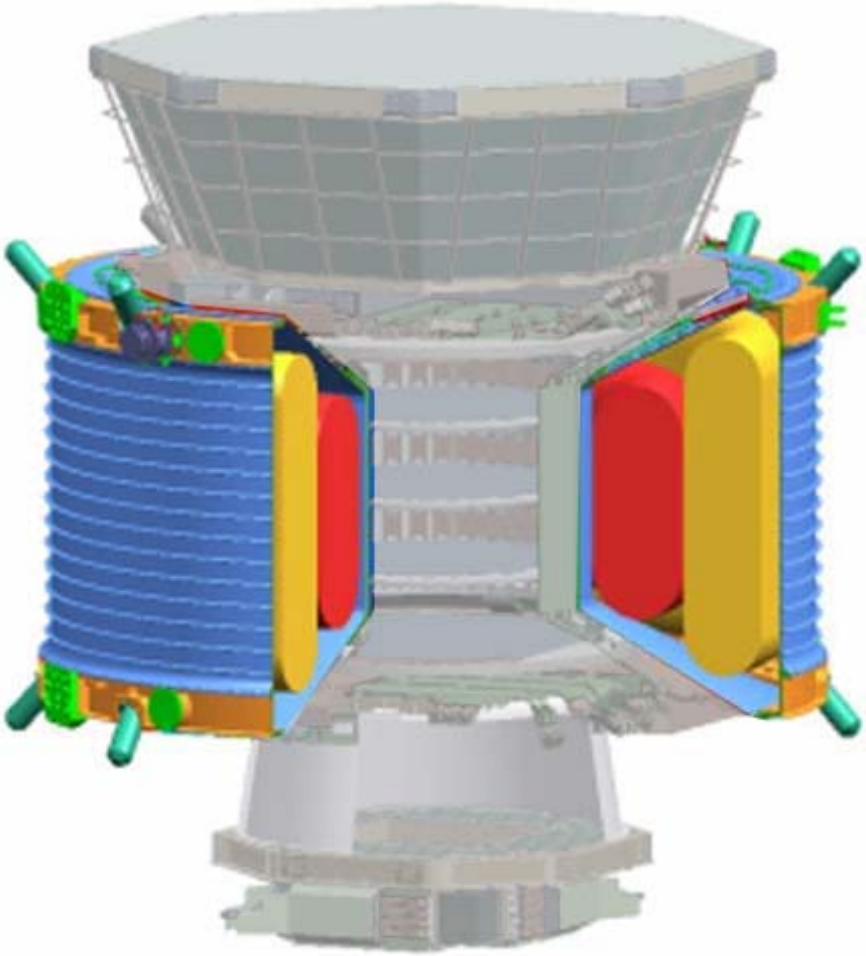

TRD
CRYOCOOLER
TCS
RADIATORS
ORBITER SILL
TRUNNIONS
PDA/ROEU
ELECTRONICS
CRATES
FRGF
CRYOGENIC
FILL PORTS
Note that there is
now only 1 fill port
THERMAL
BLANKET
USS-02
CRYOMAGNET
SUSPENSION
PORT COVER
ORBITER KEEL TRUNNION

Major AMS Detectors



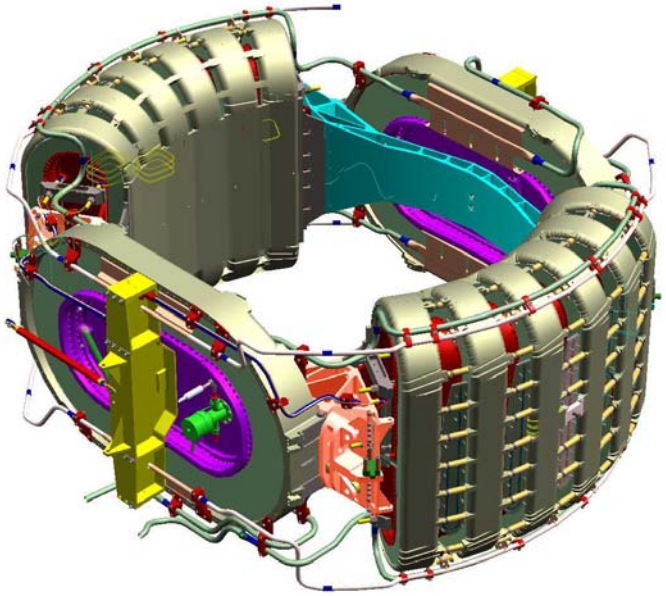

NASA
CPL
STOP


GERSAG
10 t
SWF

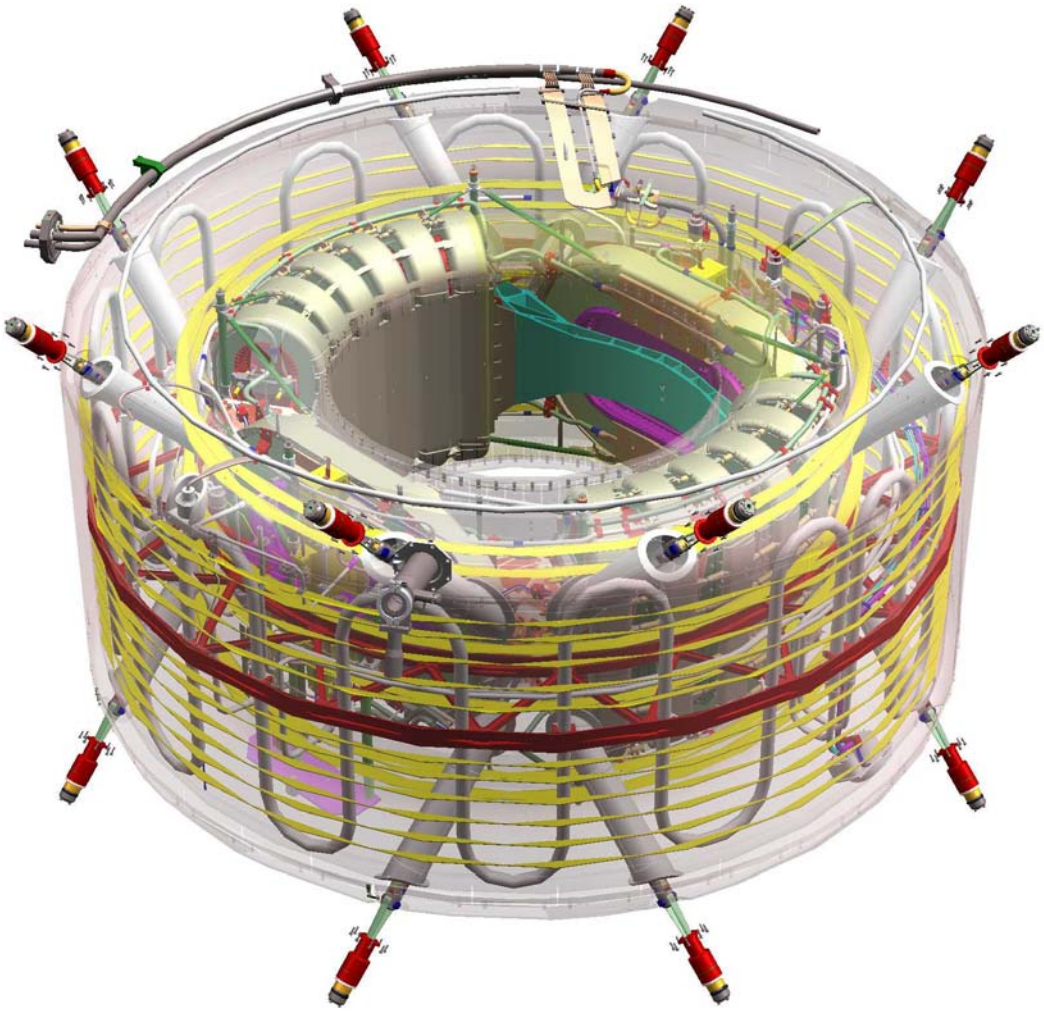


Superconducting Cryogenic Magnetic (Cryomag)

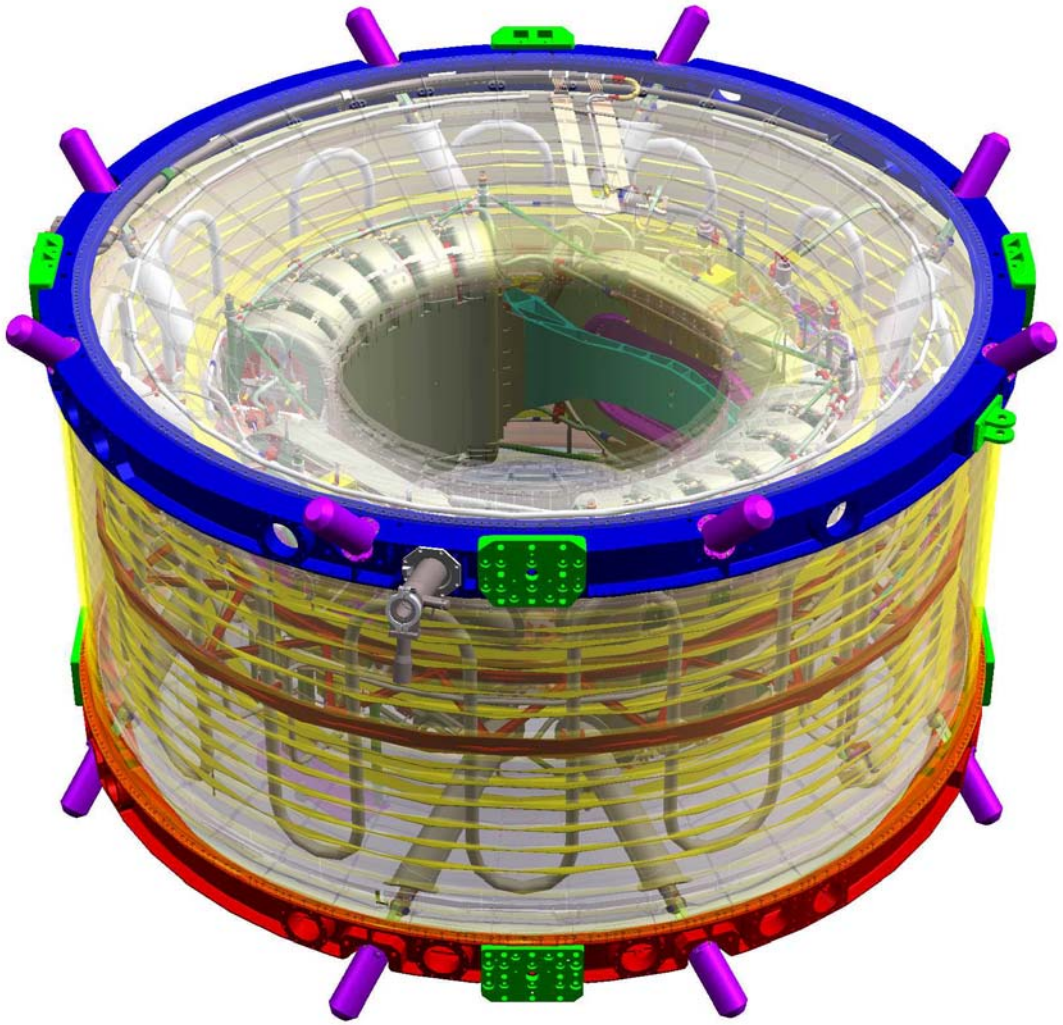
- When charged, the coils develop mutual magnetic loads which are reacted internally. The magnetic loads are considerably larger than inertial forces.
- The coils are cooled to a temperature of 1.8 K by a system of pipes…

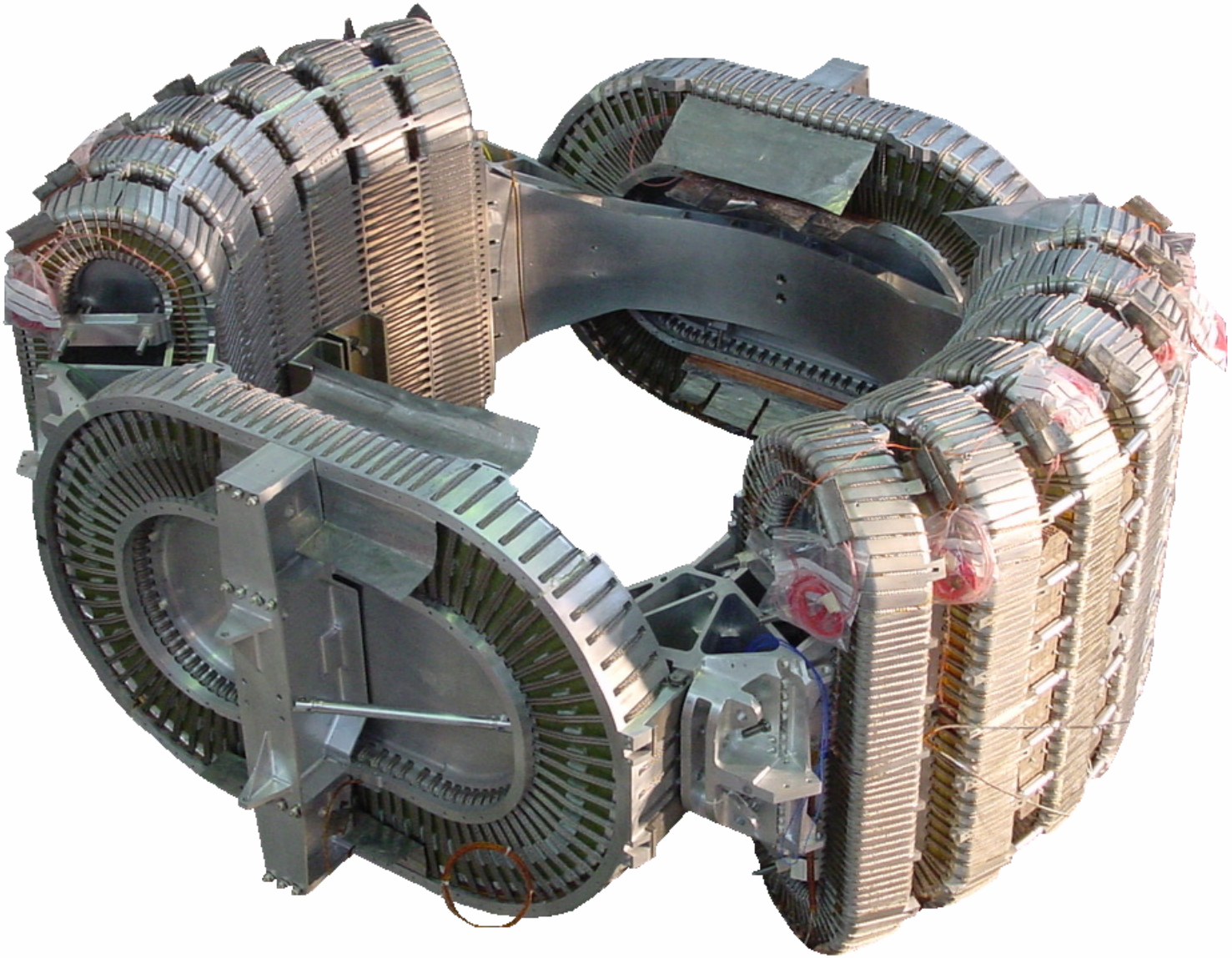


- …connected to a 2500 litre superfluid helium tank.
- The cold mass is suspended from a system of 16 composite straps.
- The coils and helium vessel are enclosed in radiation shields and multi-layer superinsulation.

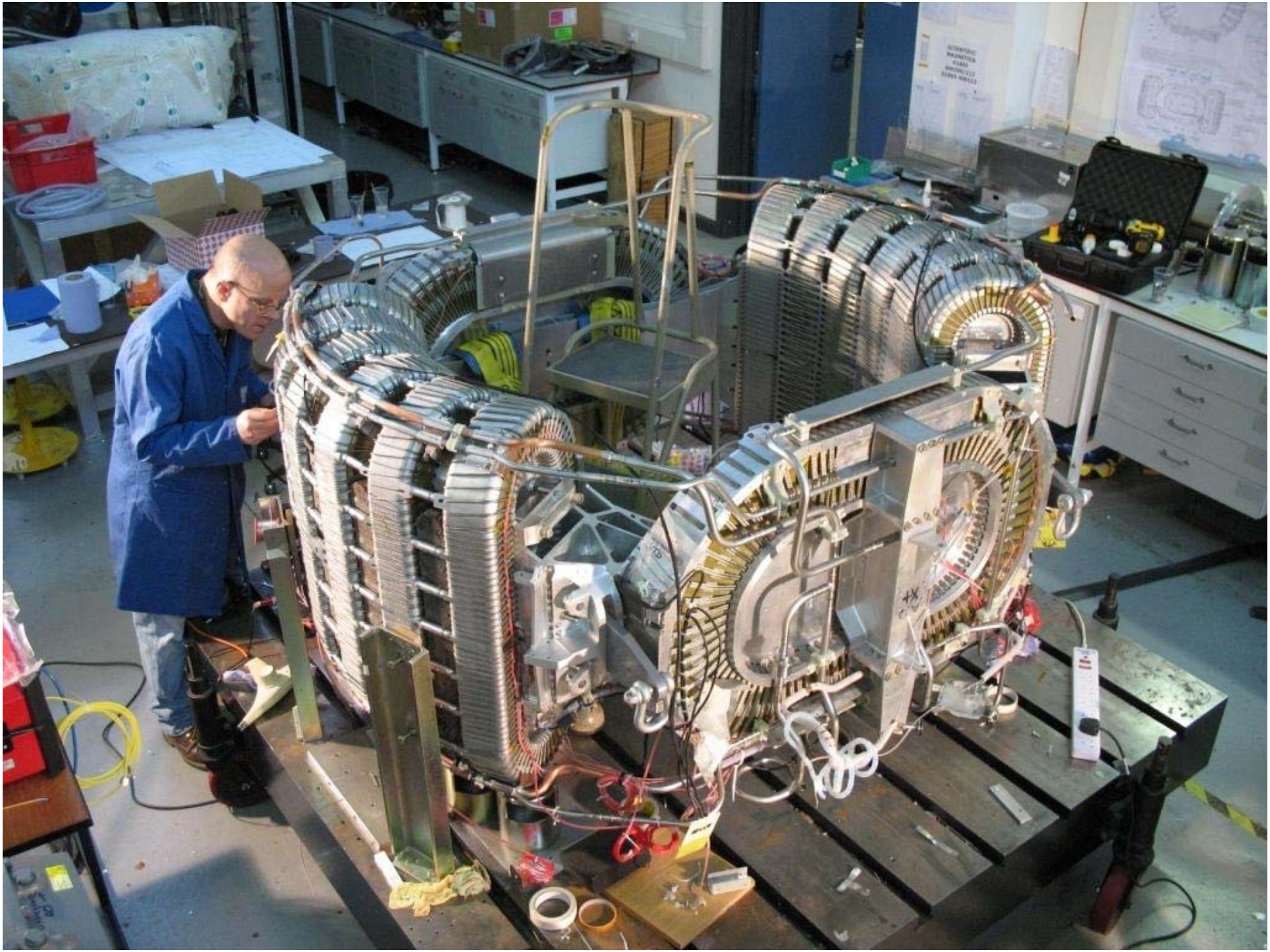


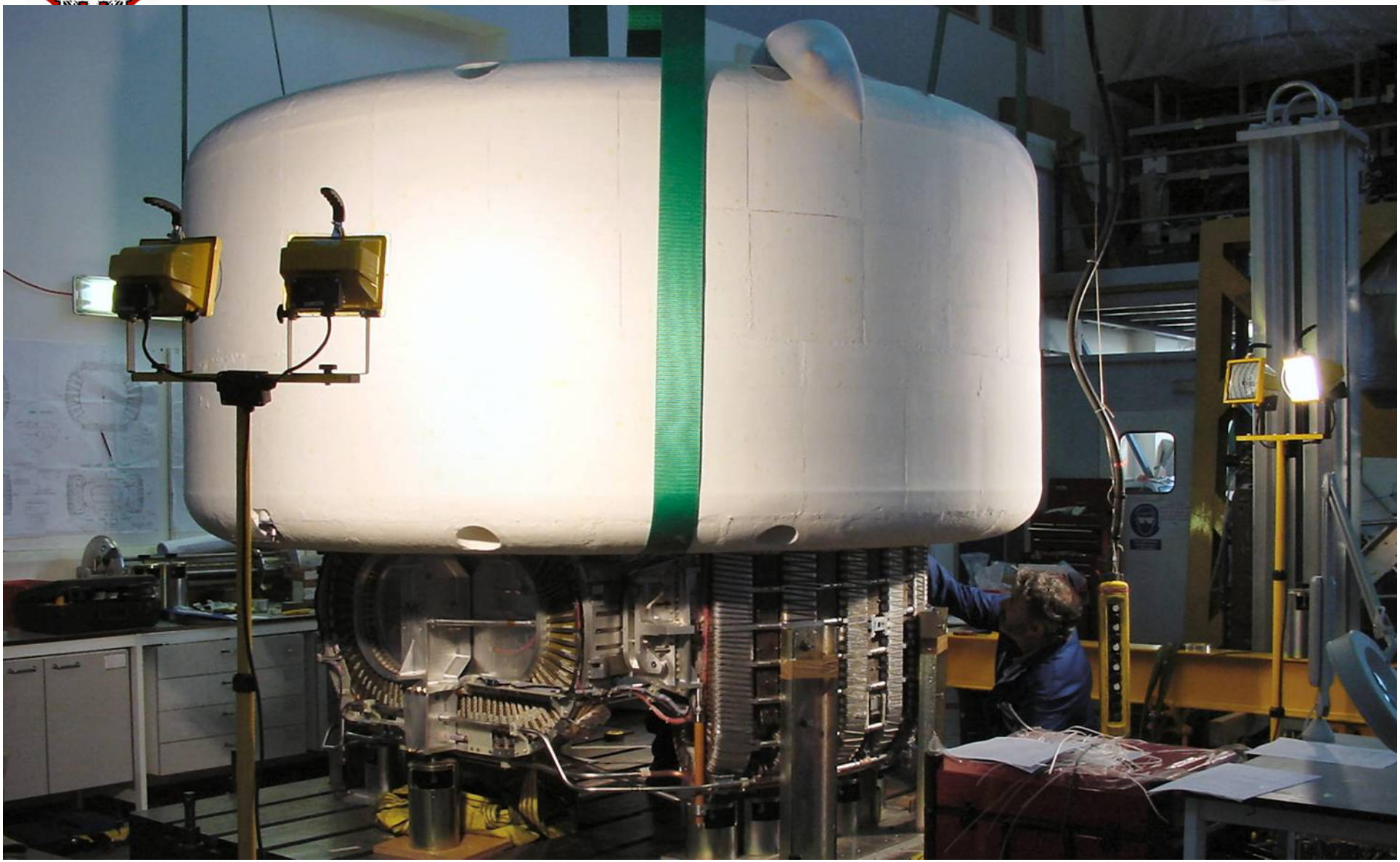
- All components are suspended within a vacuum case.



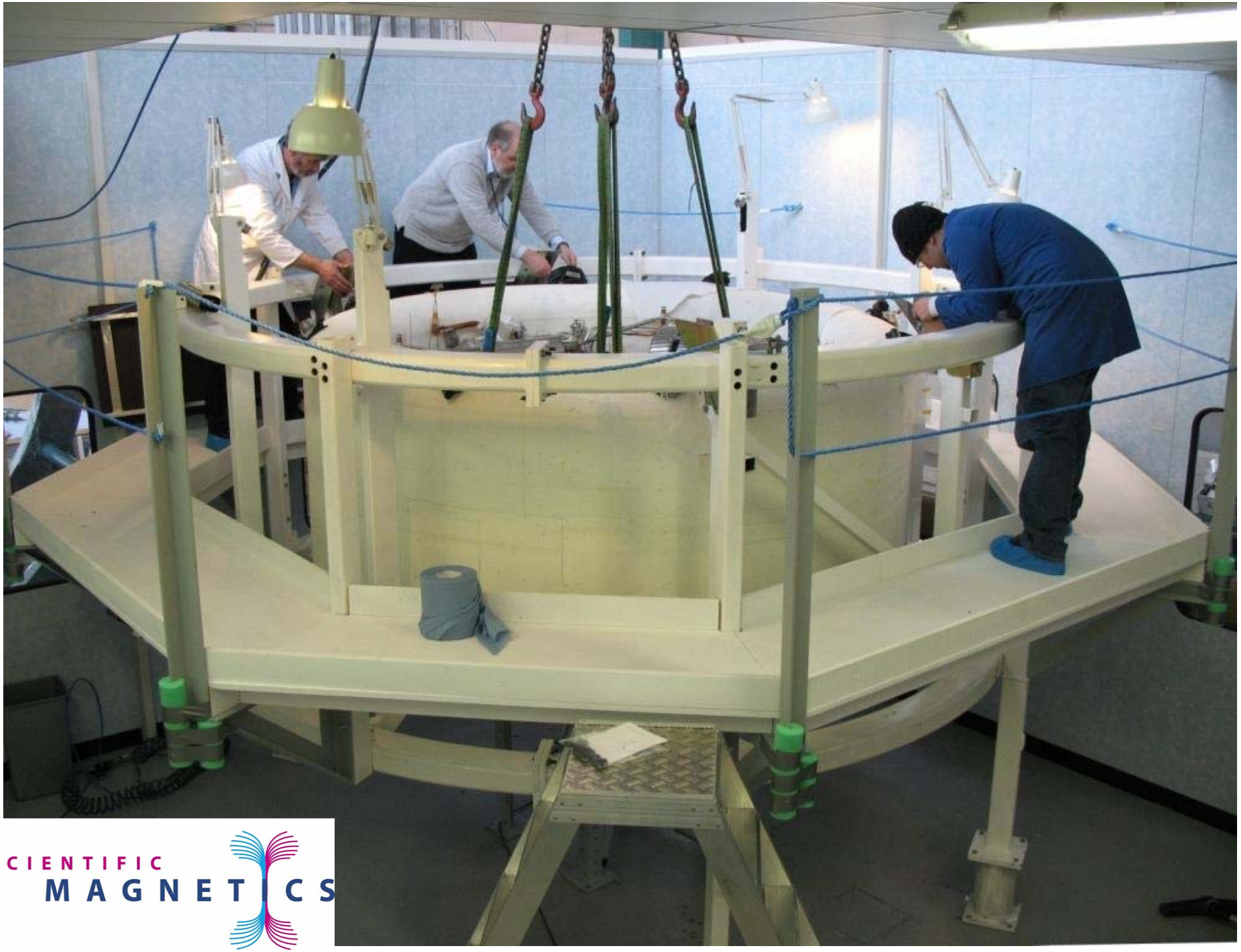


Superfluid Helium Tank

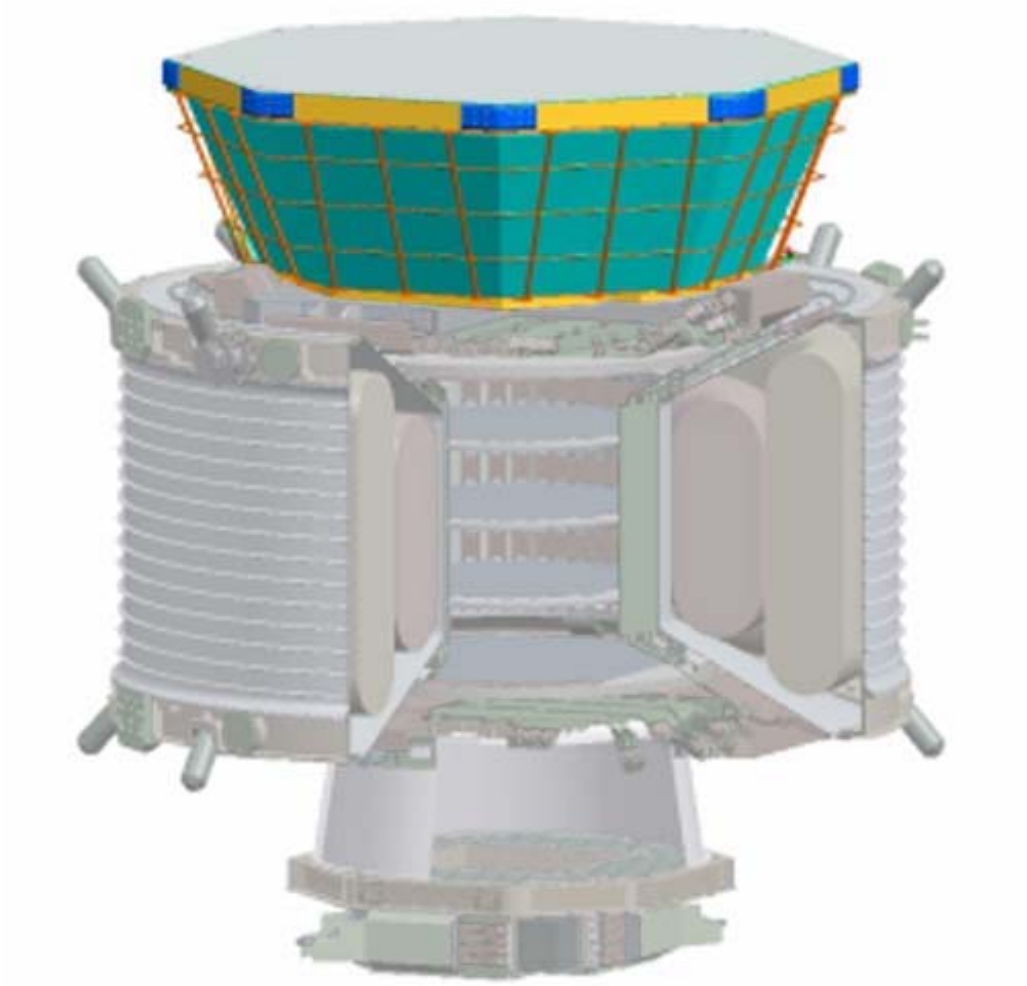




SCIENTIFIC MAGNETICS



SCIENTIFIC MAGNETICS



Transition Radiation Detector (TRD)

Transition Radiation Detector (TRD)

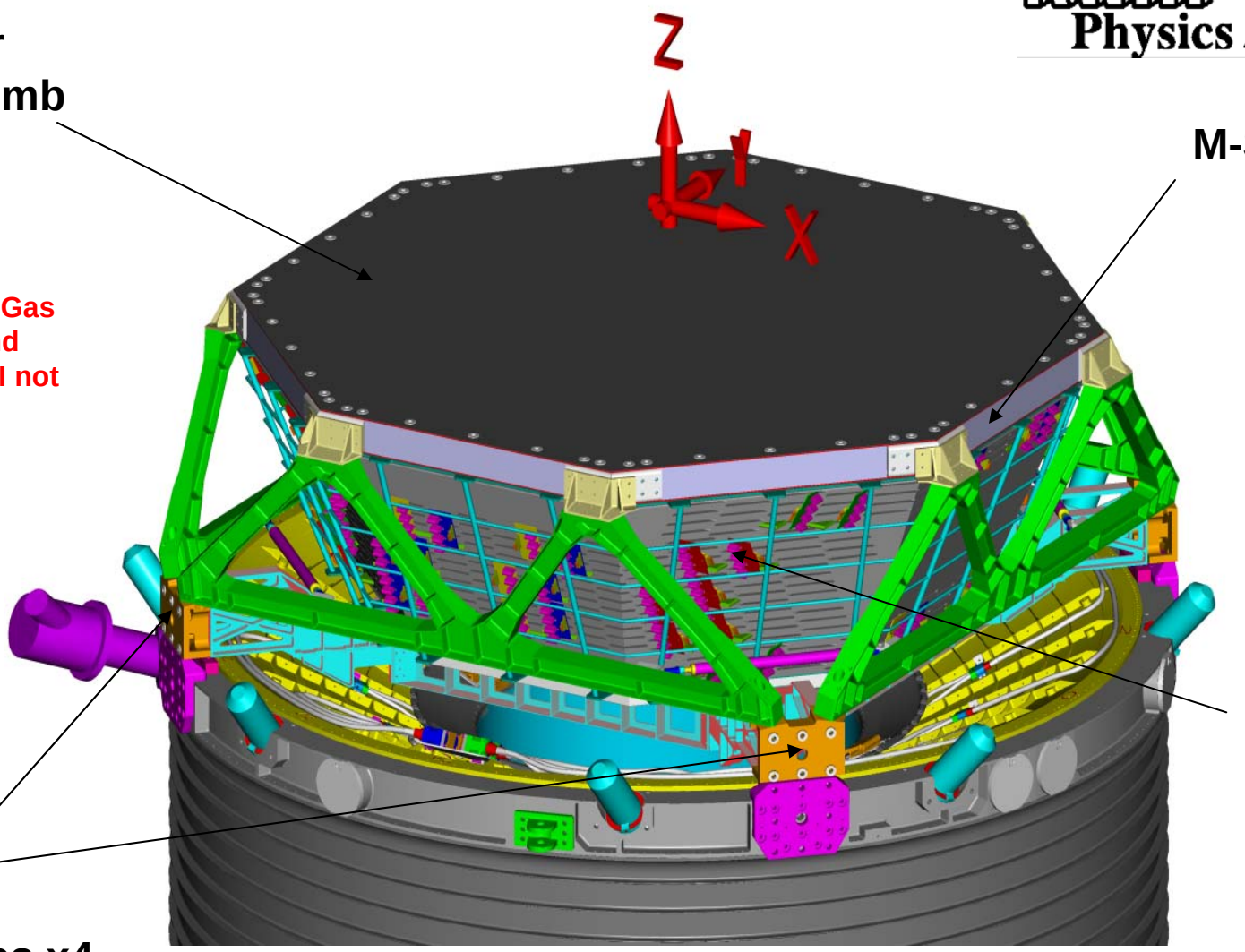
- TRD distinguishes positrons form protons, measure particle velocity and energy.
- TRD above the Upper TOF on the experiment stack
  - Octagonal shape max. size 2.31 m x 0.62 m
  - Mounts to USS-02 at four locations via the Aluminum M-Structure
- TRD Gas Supply mount to wake side of USS-02
  - Include Supply Box, Circulation Box, Gas Manifold and Plumbing System
  - TRD uses a gas system with $Xe:CO_2$ (80:20)

TRD (Cont.)

- Octagonal Support Structure and Bulkheads
- Aluminum M Structure
- 5248 proportional tubes
  - Multi-layer wound composite structure (outer diameter of 6 mm (0.24 in), wall thickness = 70 μ (.003 inches)
  - Gold plated tungsten wire (30 μ (.001 in) diameter) runs thru the center of the tube
  - Total of 20 tube layers high with a radiator material gap between each layer
- Gas Supply System (Details Covered in Another Presentation)
  - 2 Composite Over-wrapped Stainless Steel - Pressure Vessels
  - 1 Stainless Steel Mixing Tank – Pressure Vessel
  - 1 Stainless Steel Box C Cylinder – Pressurized Component
  - Plumbing system – Pressurized Components
  - System covered by Meteoroid and Orbital Debris Shield

TRD Structure

RWTH Physics AC-I



Upper Honeycomb

M-Structure

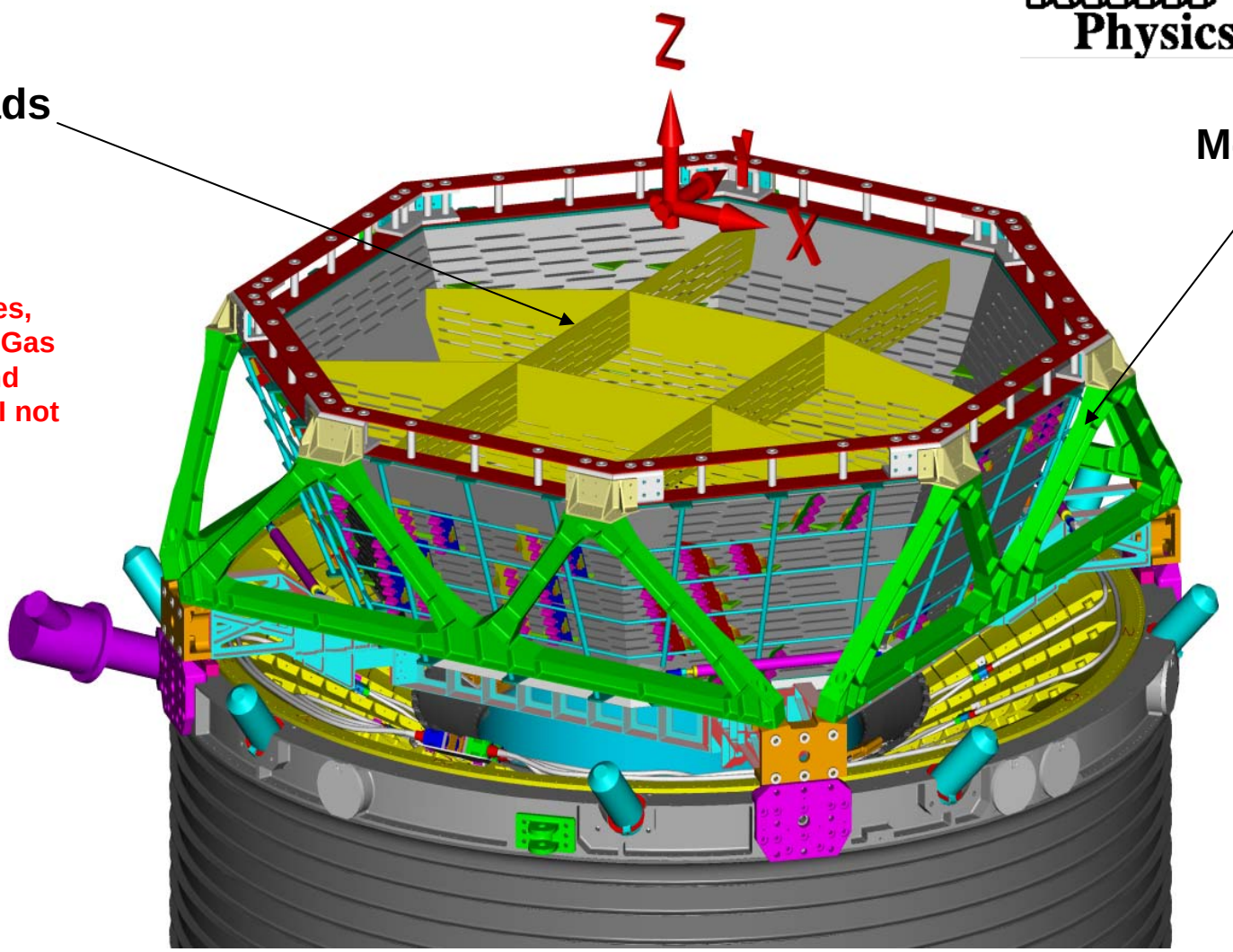
Electronics, Gas piping, and Closeout MLI not shown

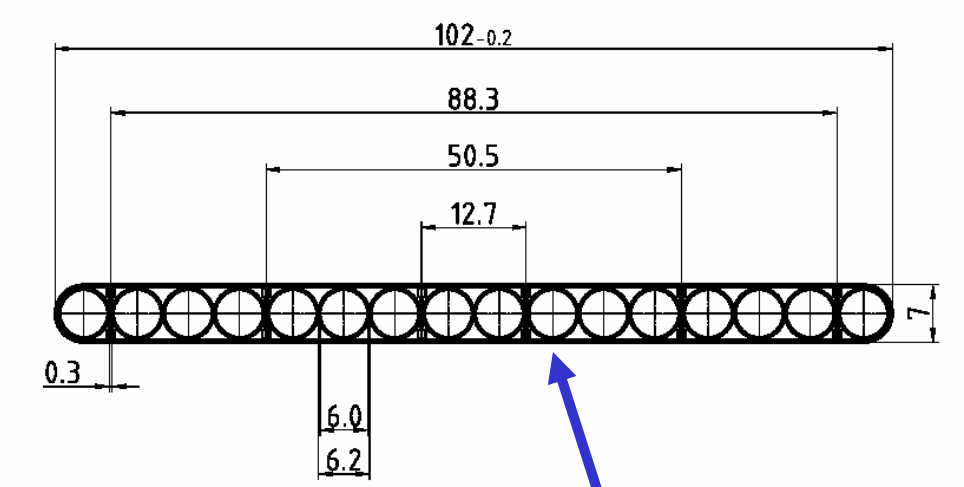
Octagon

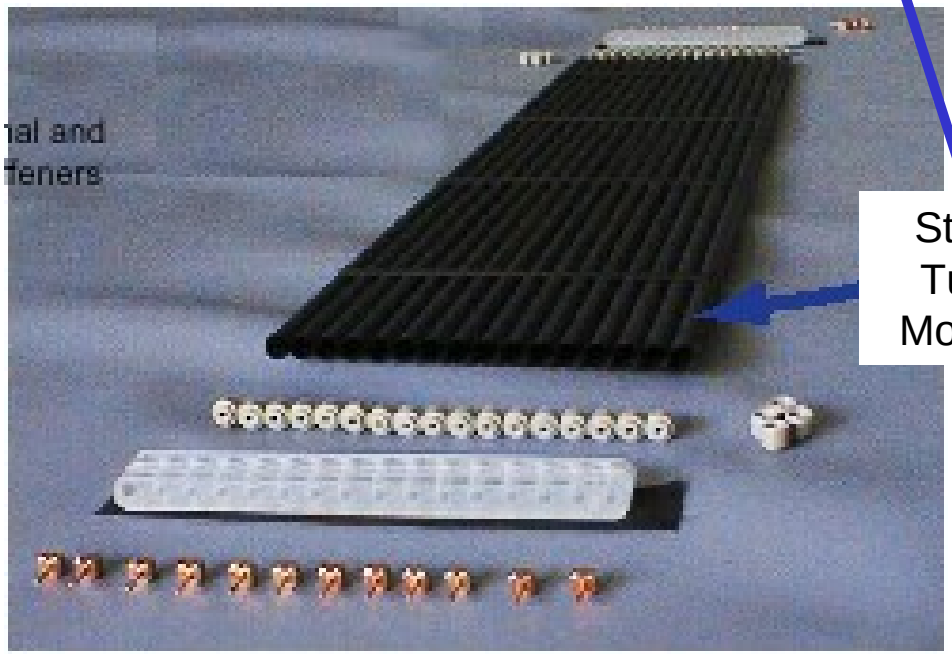
USS-02 Interfaces x4

TRD Structure

RWTH Physics AC-I



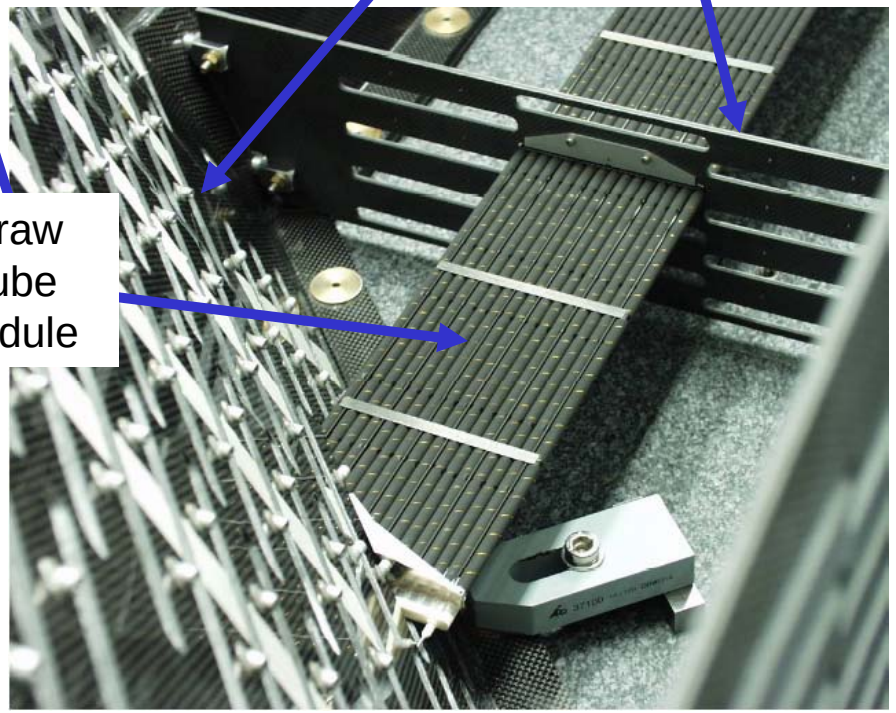


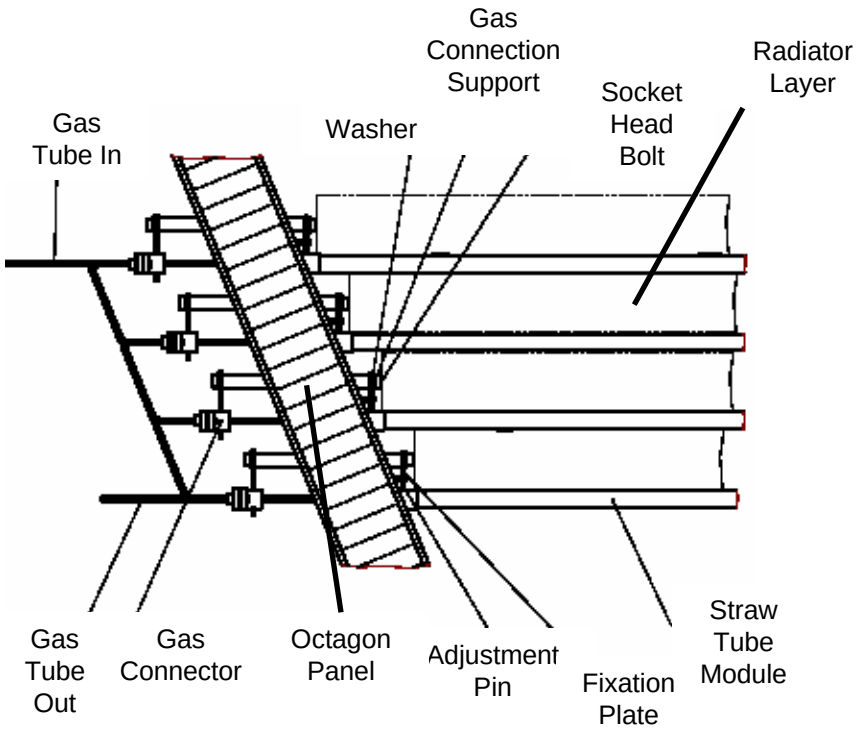


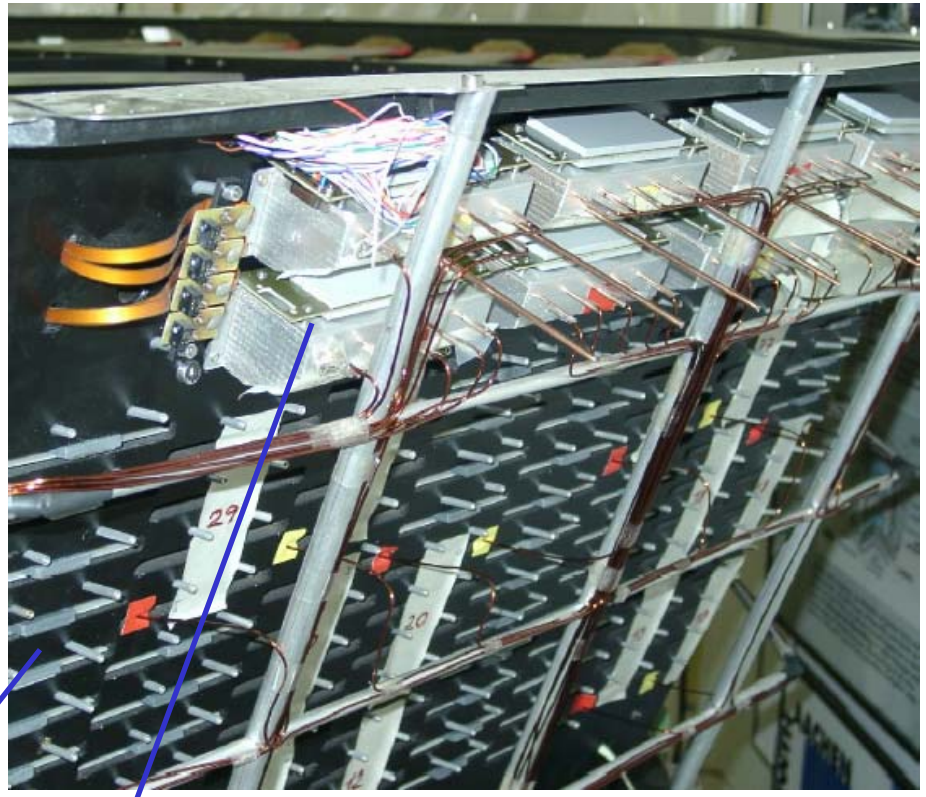
Straw Tube Module

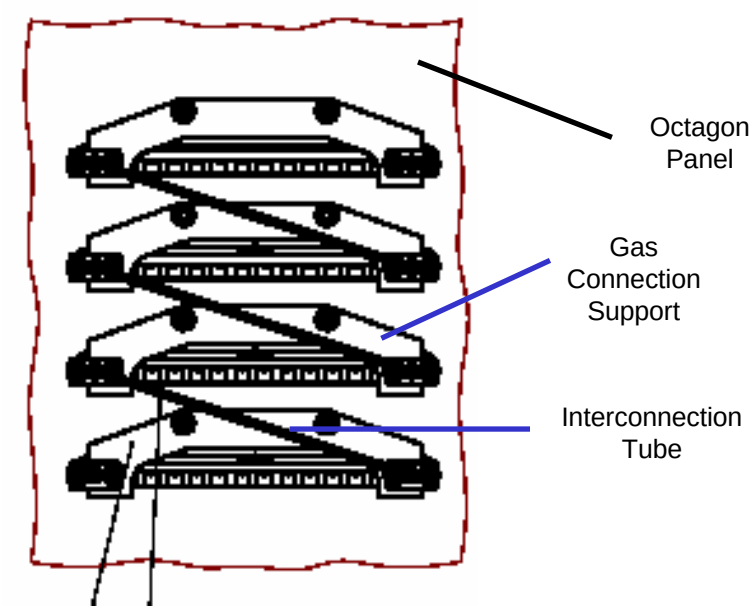
Octagon Wall

Bulkhead





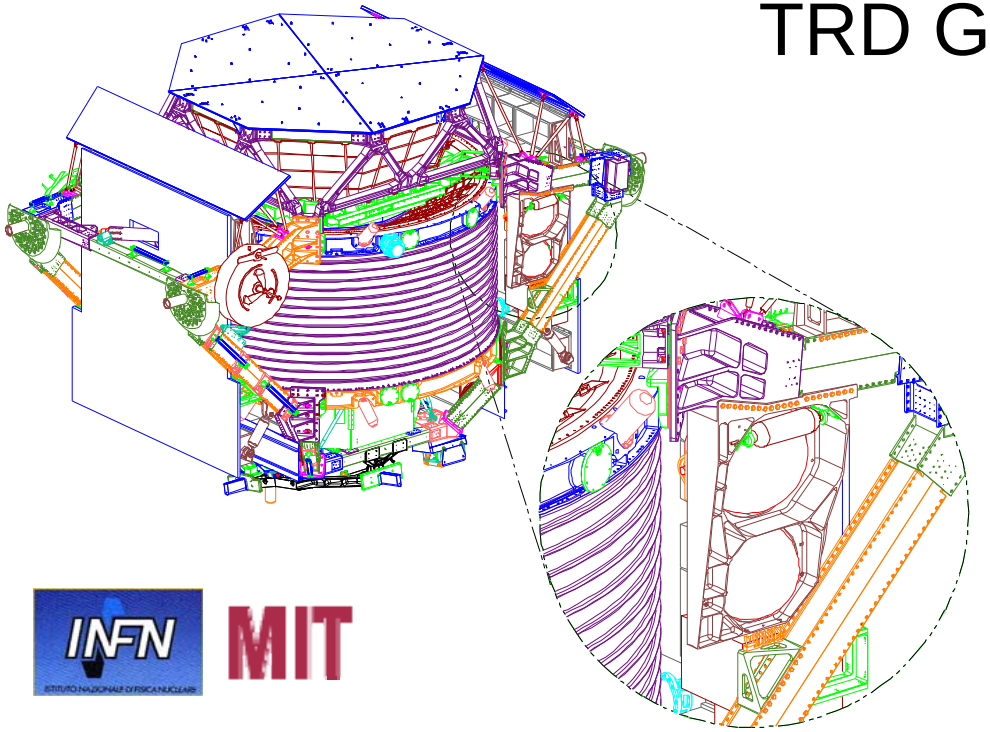


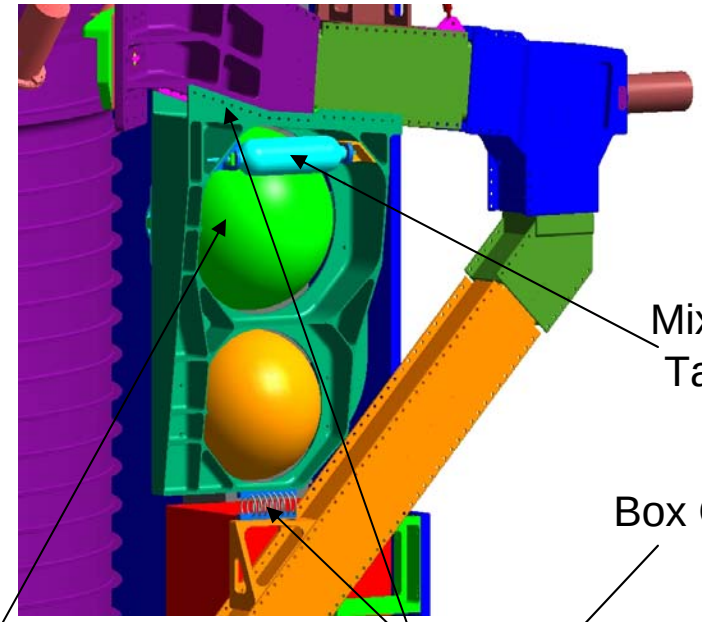


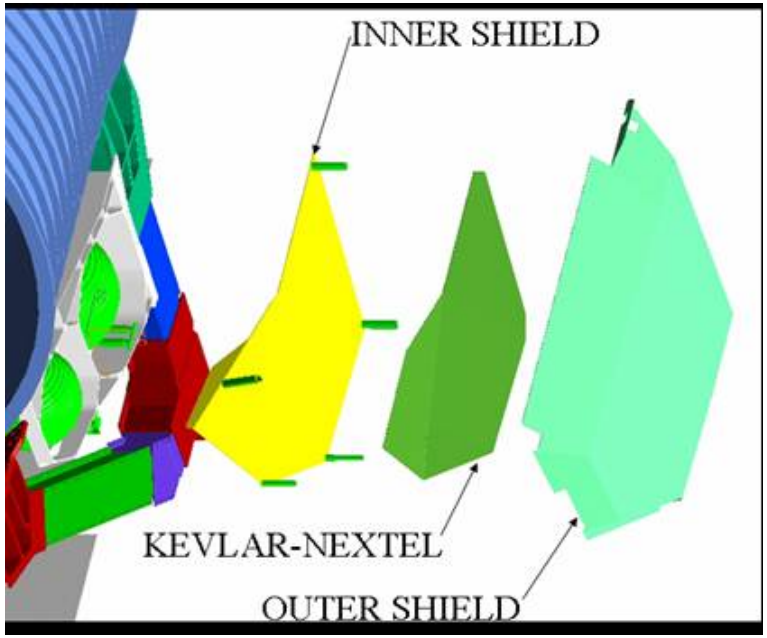
Gas
Segment
Valve Box

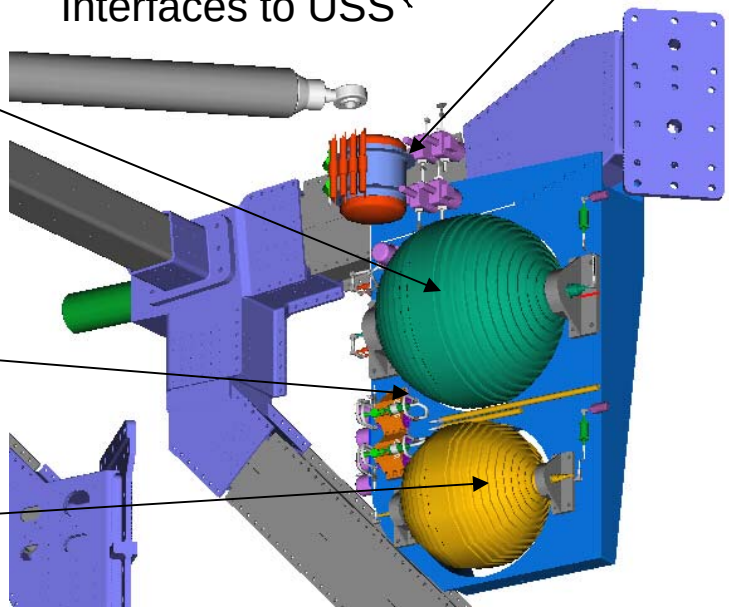
TRD Module Feed-Thru at Octagon Wall and Connection to Gas System

TRD Gas Supply System

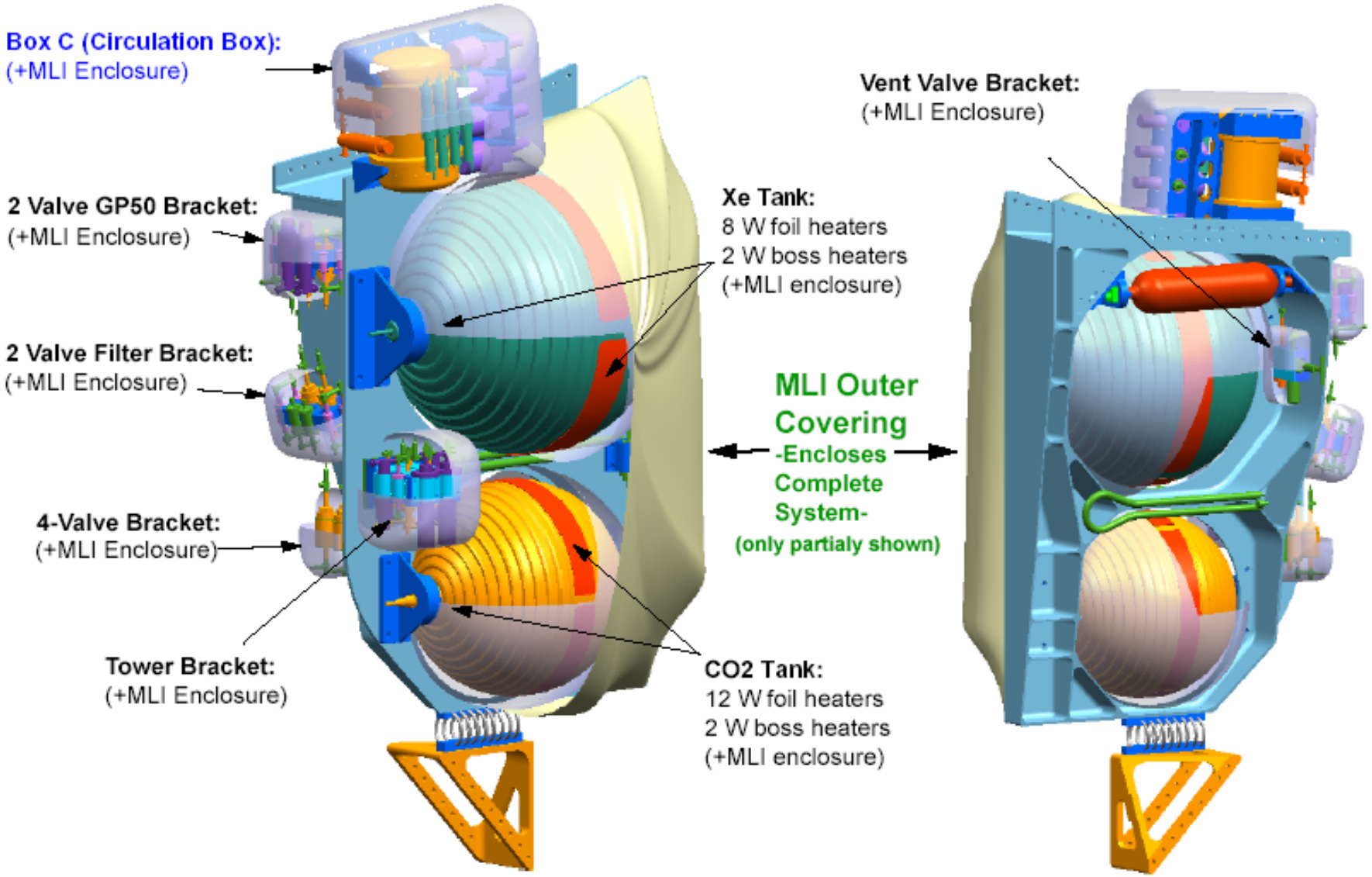






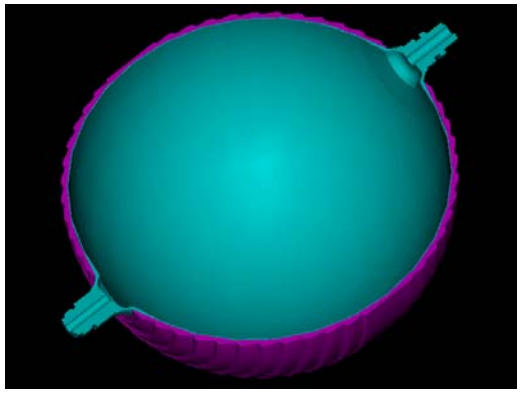


TRD Gas Supply System

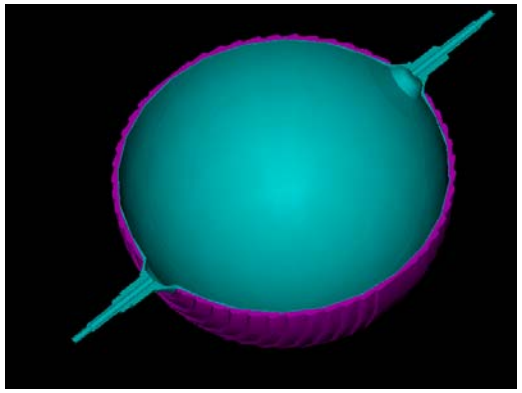


TRD Gas Supply Pressure Vessels

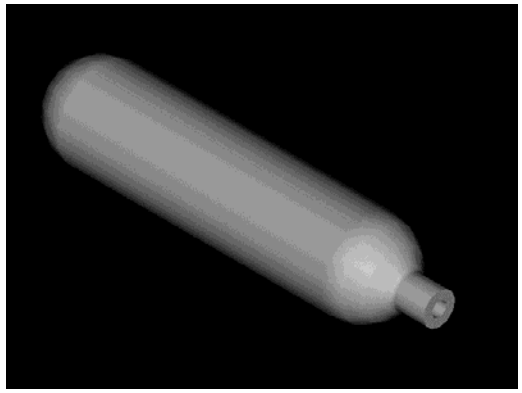
Xenon Tank



CO_2 Tank



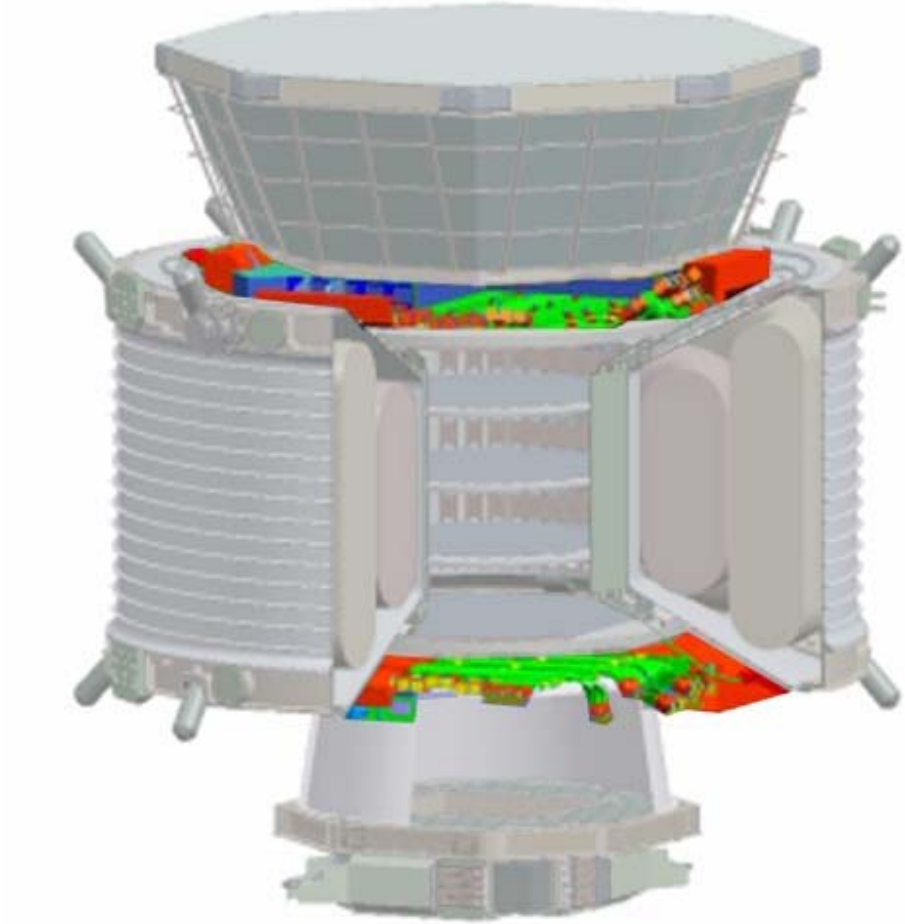
Mixing Tank



	Xenon Tank	CO_2 Tank	Mixing Tank
Model	D4815	D4816	SKC 13181
OD (in.)	15.37	12.42	
Volume ($in.^3$)	1680	813	61
Tank Weight (lbs)	17	9.5	
Gas Weight	109	11	
Material	Composite over-wrapped stainless steel	Composite over-wrapped stainless steel	Stainless steel
Arde qualification documents	EG10330, July 6, 2001	EG10331, July 6, 2001	EG 10348, Nov. 6, 2001


AMS-02


AMS-02



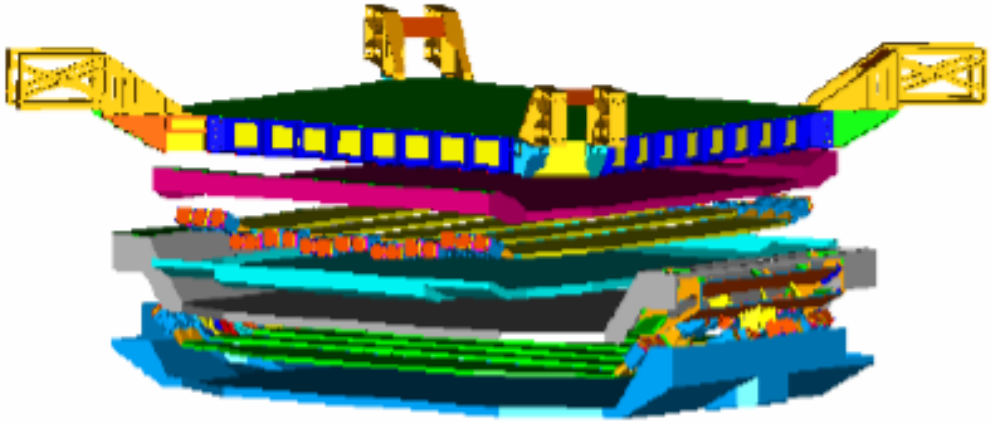
Time of Flight (TOF)

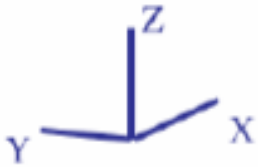
Time of Flight (TOF)

- TOF measures magnitude and direction of particle velocity and the charge magnitude. Also serves as a trigger for entire experiment
- TOF systems are being developed by the same groups that developed the STS-91 TOFs
- Size, Location, and Description
  - Two ~1.5 m diameter honeycomb structures
  - Support scintillator detectors and photomultipliers
  - Located above and below the outer most planes of the Tracker

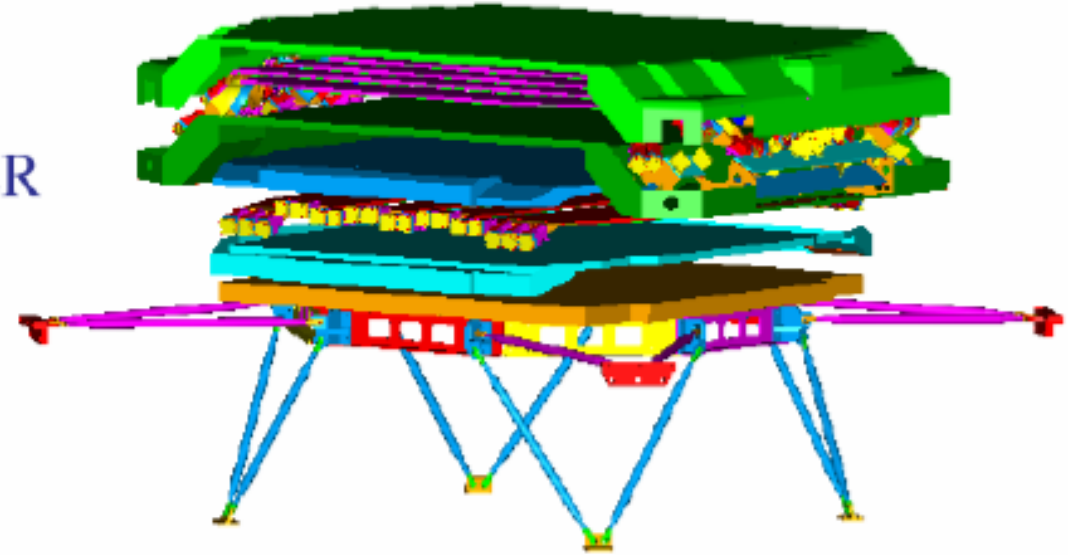
AMS II ToF

UPPER



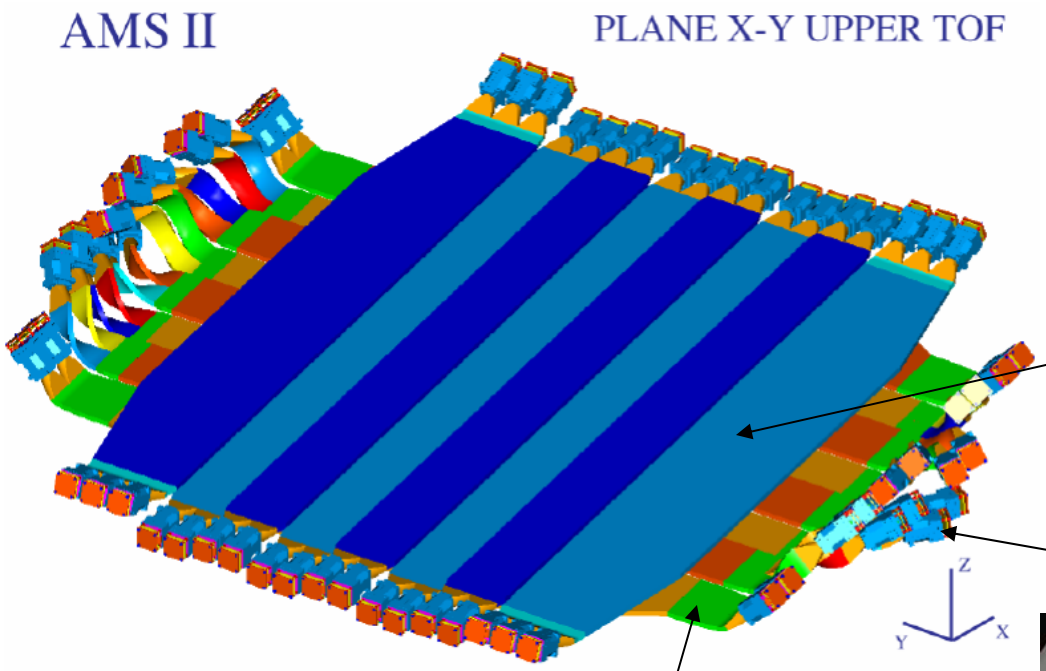


LOWER



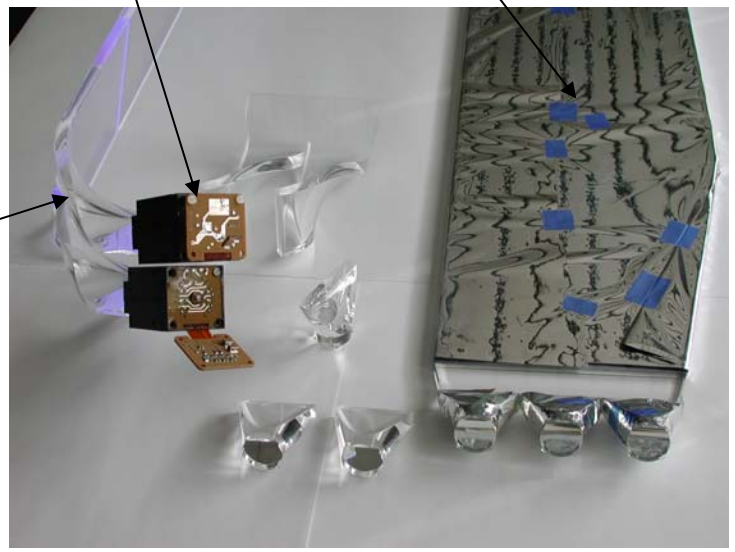
Carlo Gavazzi Space SpA

Carlo Gavazzi Space SpA

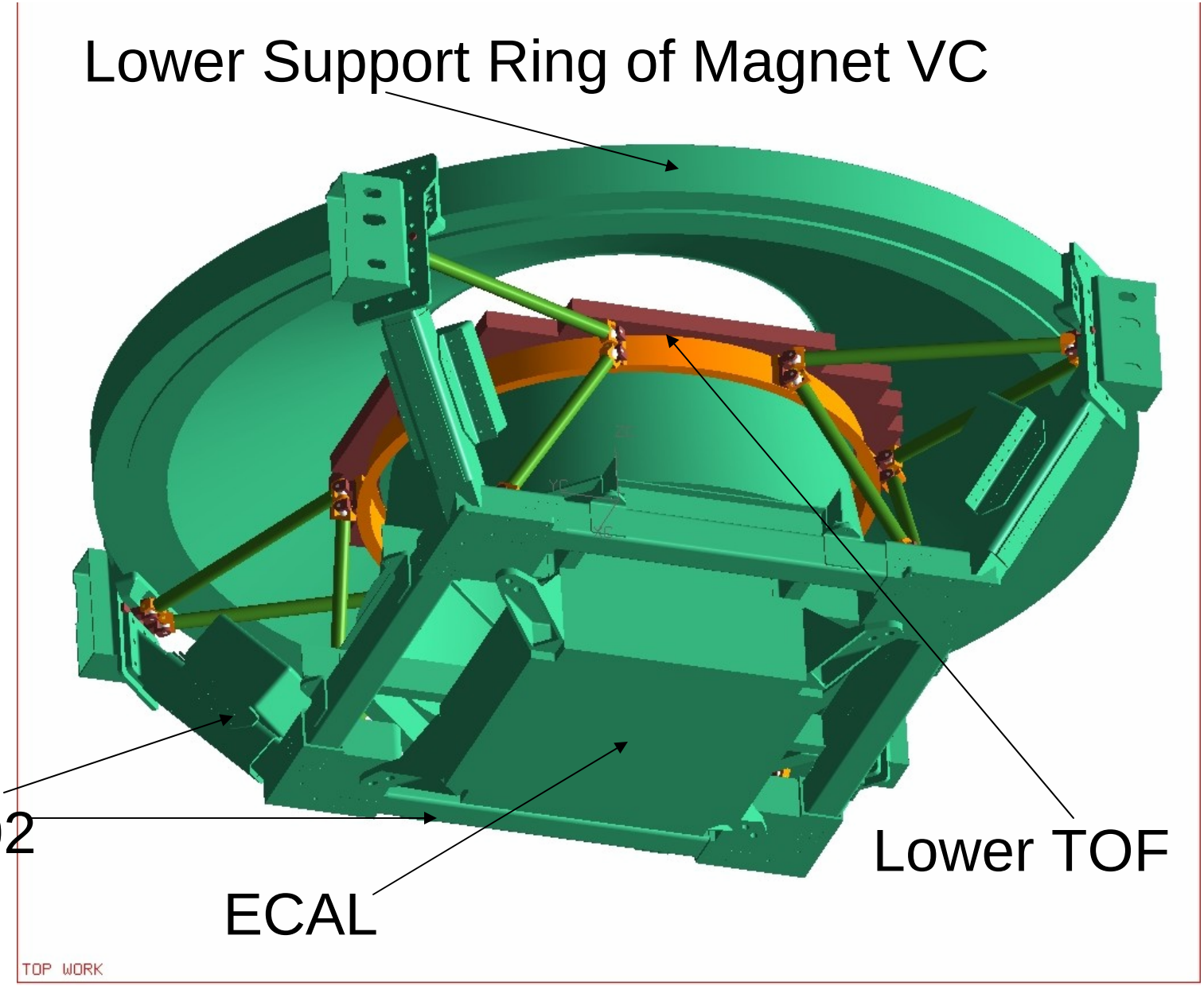


Scintillator Panel

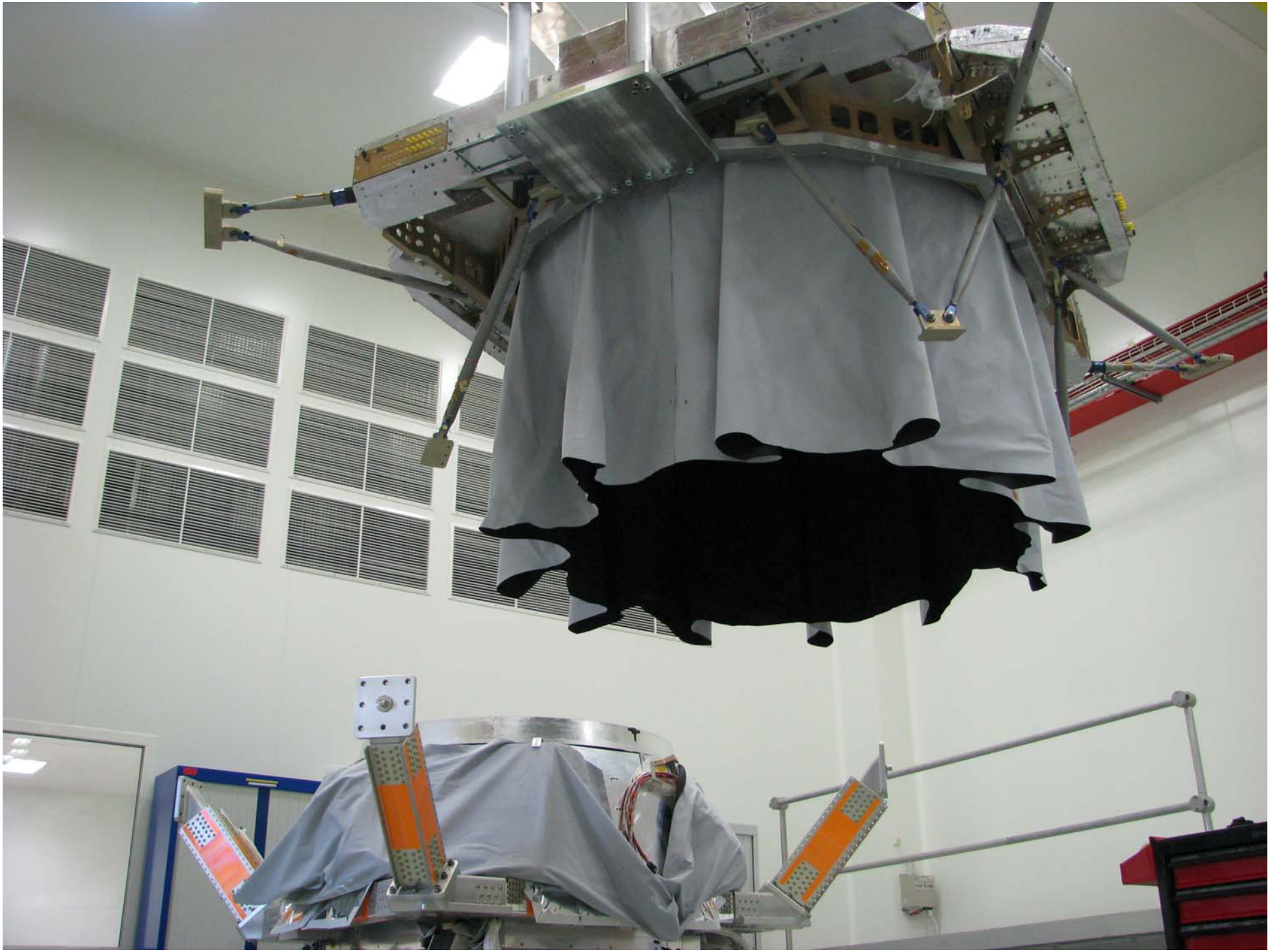
PMT

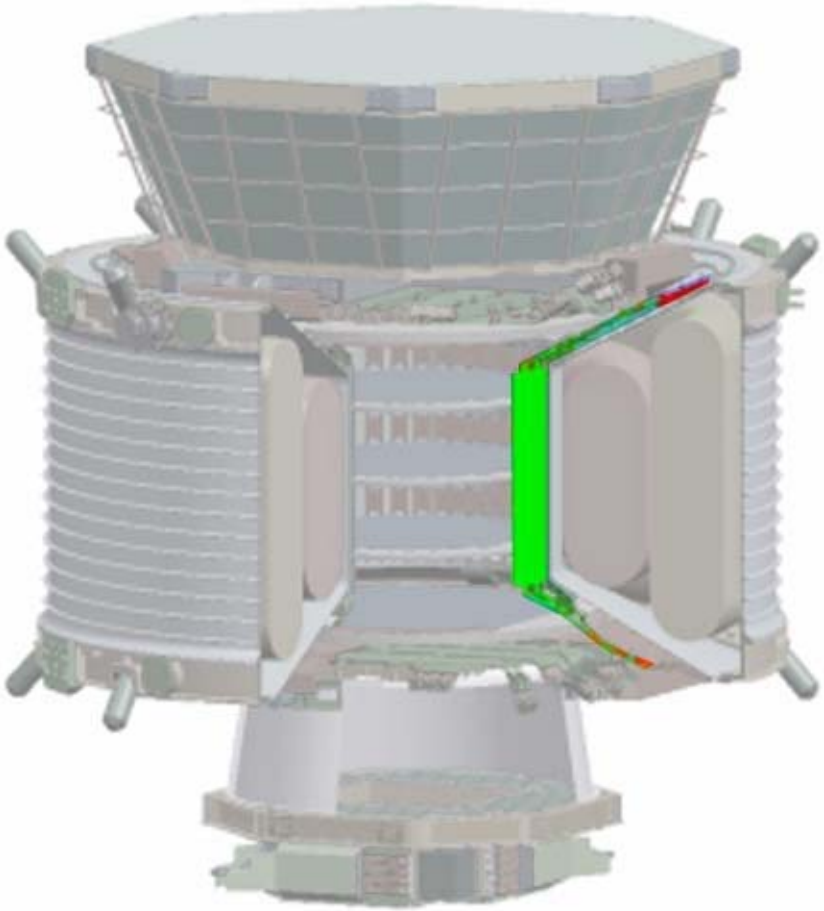


Light Guides


Lower Support Ring of Magnet VC
Lower
USS-02
ECAL
Lower TOF
TOP WORK

Lower Time of Flight Integration



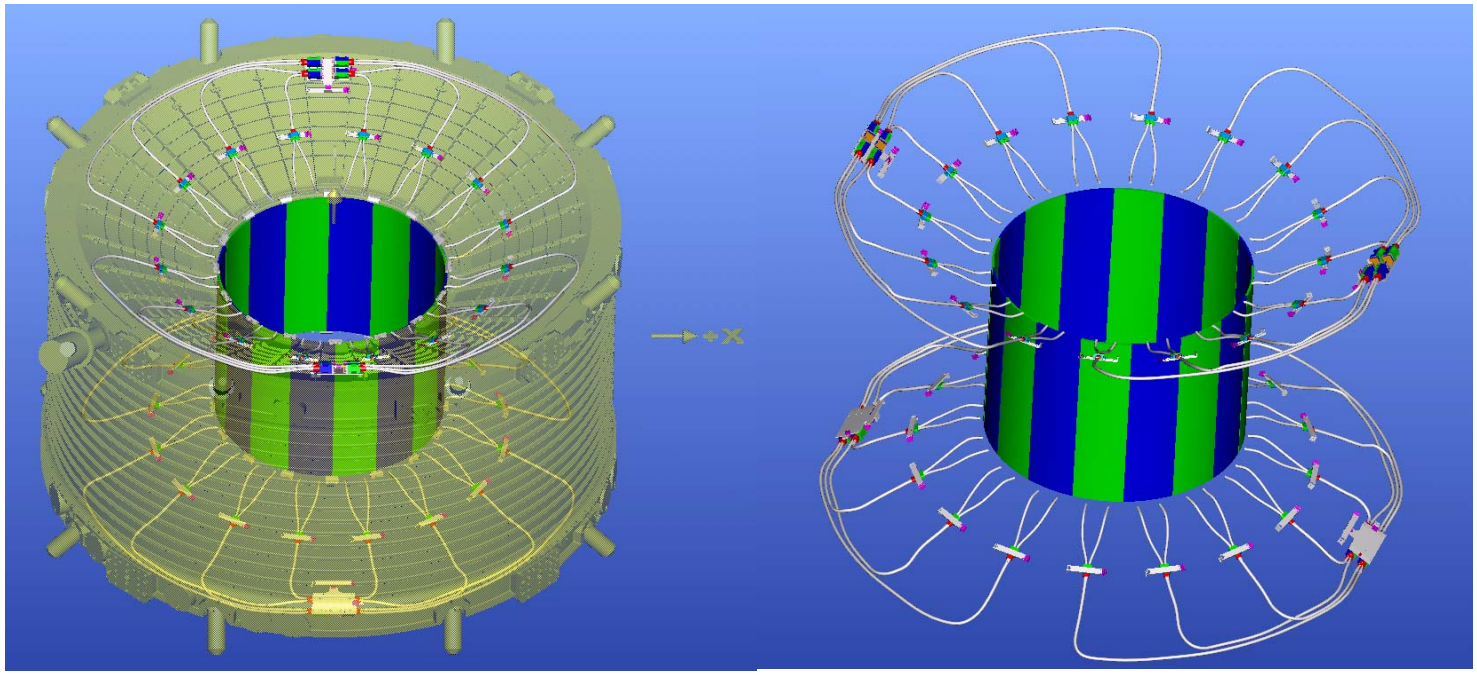


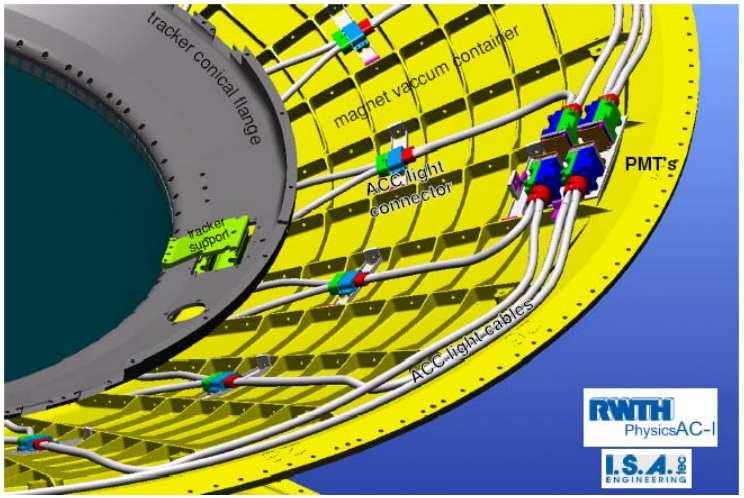
Anti-Coincidence Counter (ACC)

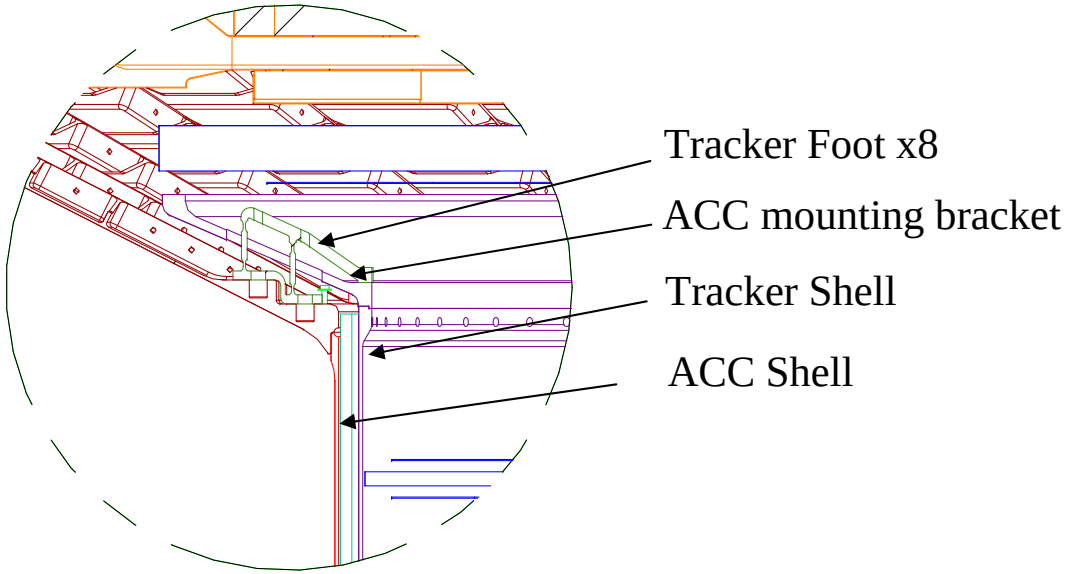
Anti-Coincidence Counter (ACC)

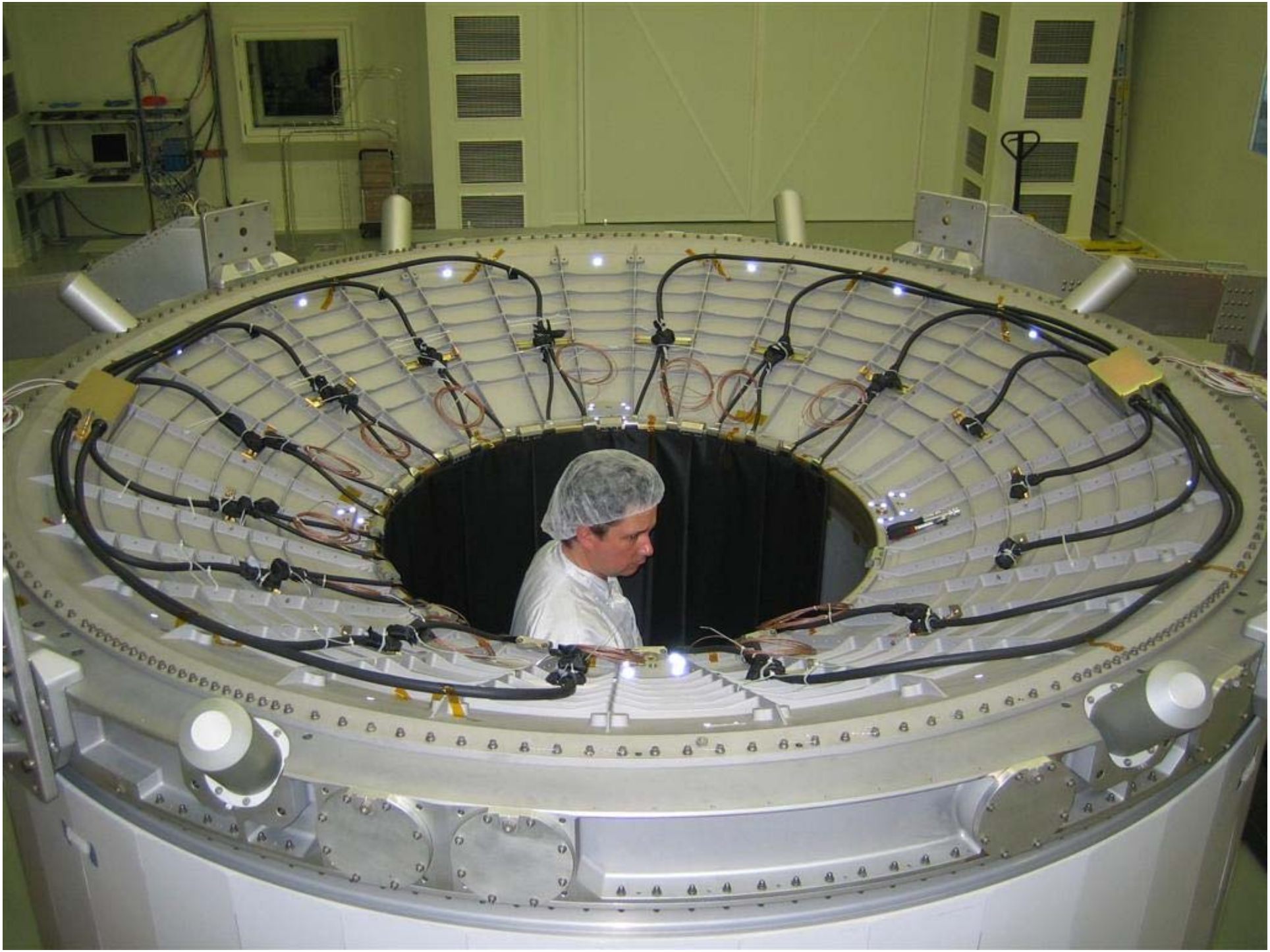
- Notes:
  - Identical carbon fiber cylindrical structure to the ACC that was flown successfully on STS-91
- Size, Location, and Description
  - Mounts to inside diameter of VC Conical Flange
  - Carbon Fiber (Tenax) / Epoxy Resin (Araldite LY556) Composite System for Support Tubes
  - Scintallator Panels
  - Surrounded by Photomultiplier Tubes which are contained in support structure

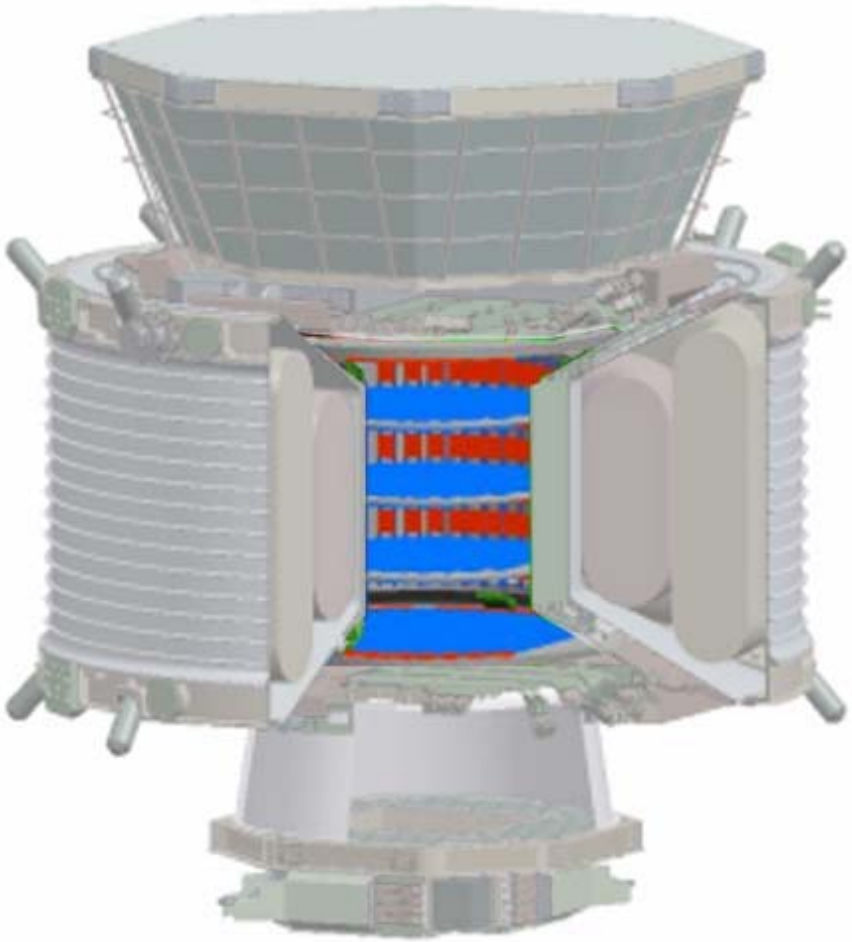
RWTH Physics AC-I











Tracker

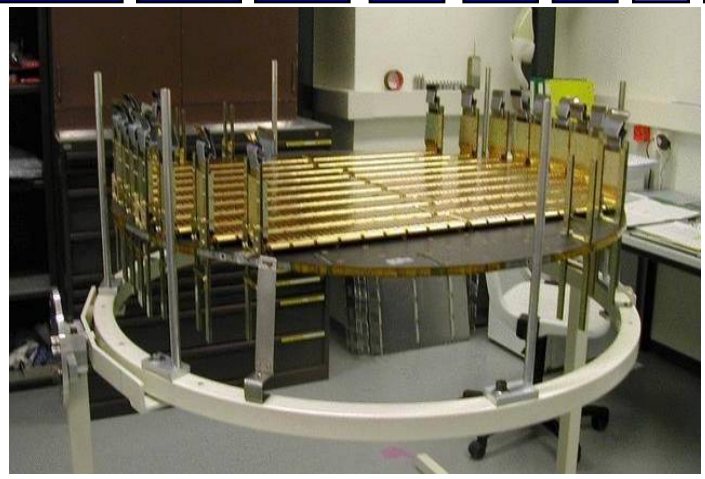
Tracker

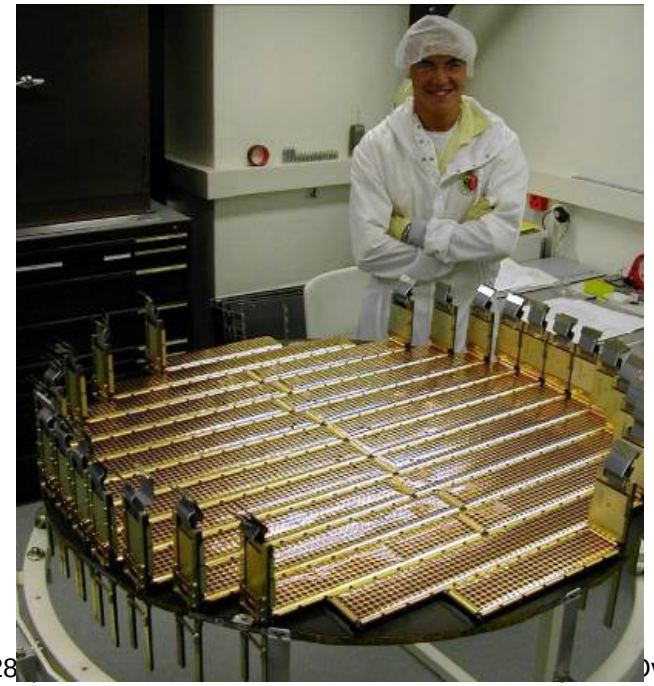
- The Tracker measures the trajectory of the particles as it bends in the magnetic field, determines the charge sign and magnitude and the resulting momentum.
- Location and Size
    - Tracker is located inside the inner cylinder of the vacuum case
    - Mounts at 8 attach locations to the vacuum case flanges (changes made to Tracker Feet for AMS-02)
    - 3 Inner planes approximately 1.1 meters in diameter (were 4 on STS-91)
    - 2 Outer planes approximately 1.5 meters in diameter
    - Tracker Support Plates, Cylindrical Shell, & Conical Flange – M55J Fiber / Cyanate Ester Composite facesheet and Hexcell Composite Honeycomb Core
    - Tracker Ladders – Carbon Fiber / Cyanate Ester Composite for Ladder re-enforcement, 7075 Al. Legs, Airex Foam
    - Support Feet - Titanium Ti6AlV4
    - System includes Tracker Alignment System - Laser

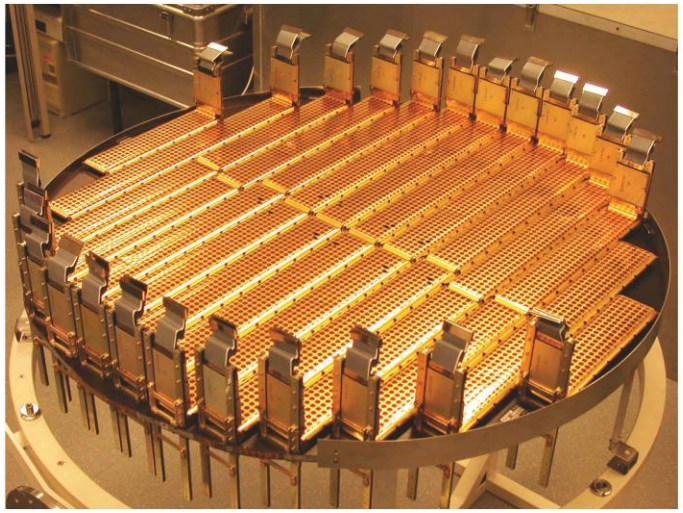
Silicon Tracker

All 8 planes (200,000 channels) have been produced

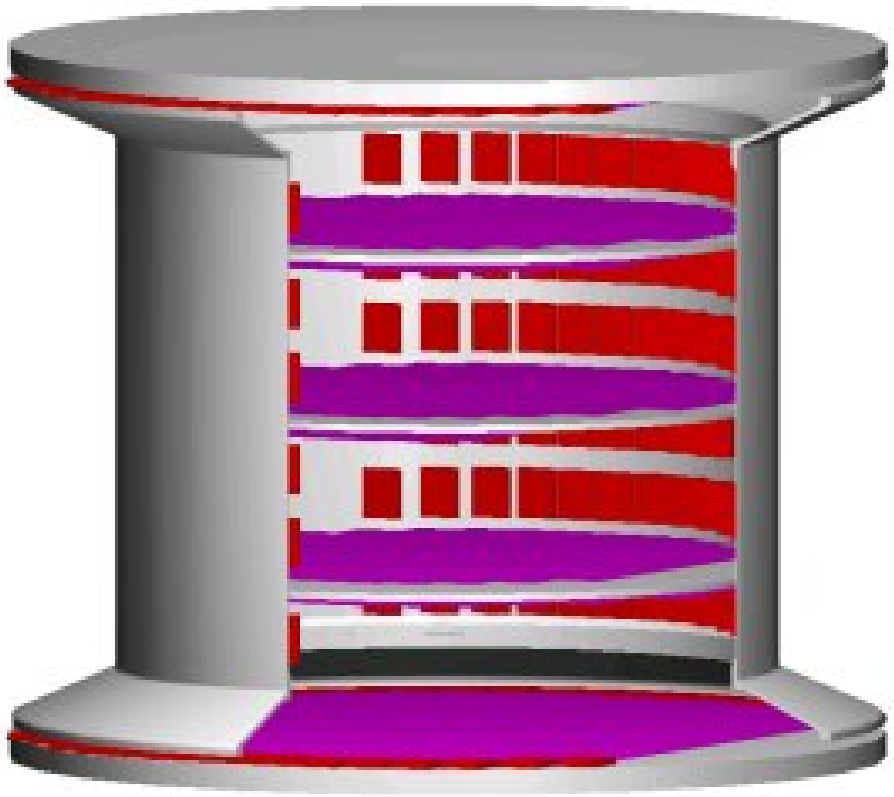
Coordinator: R.Battiston



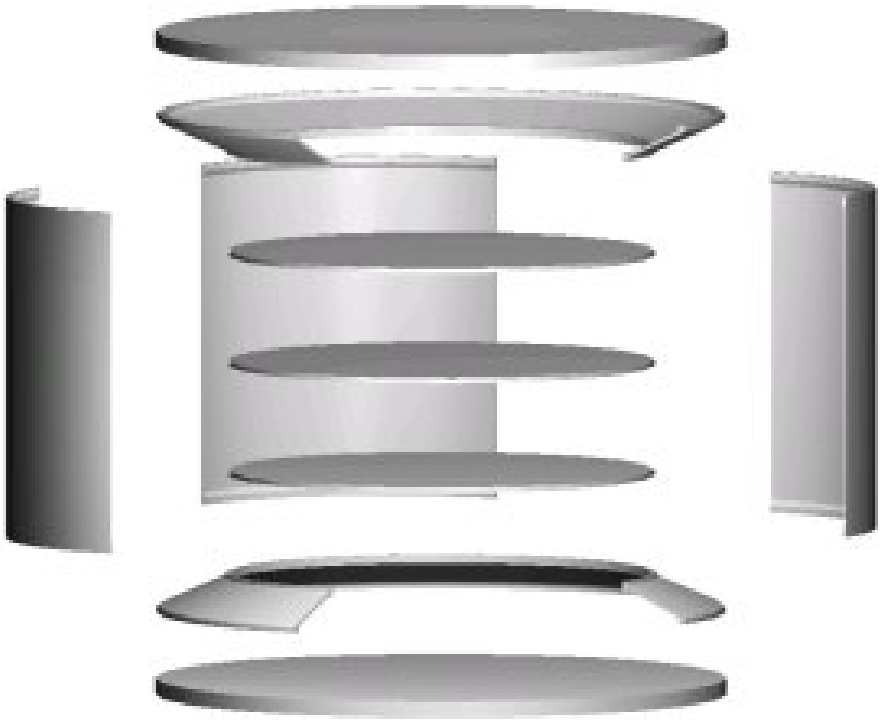




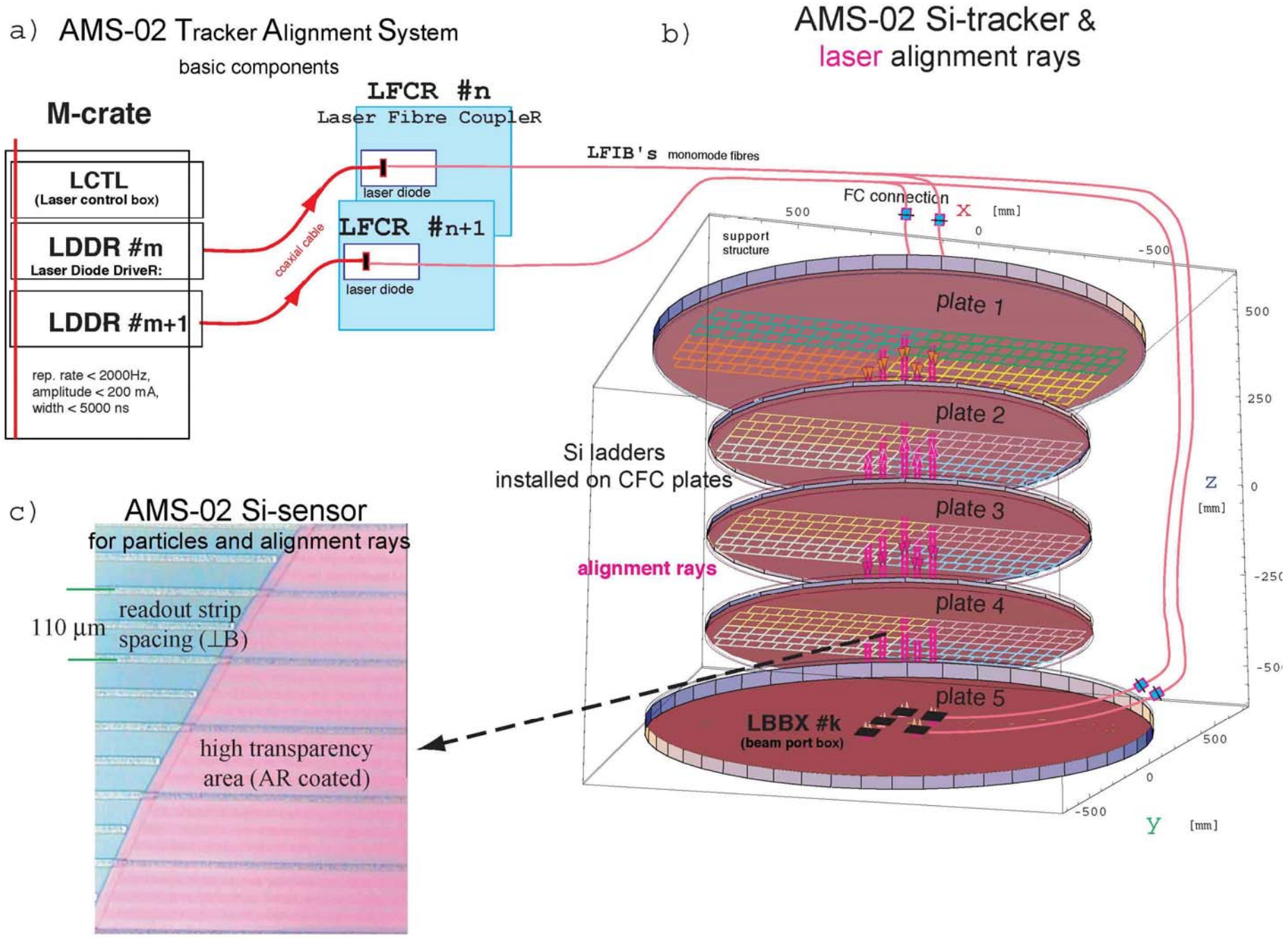
Tracker

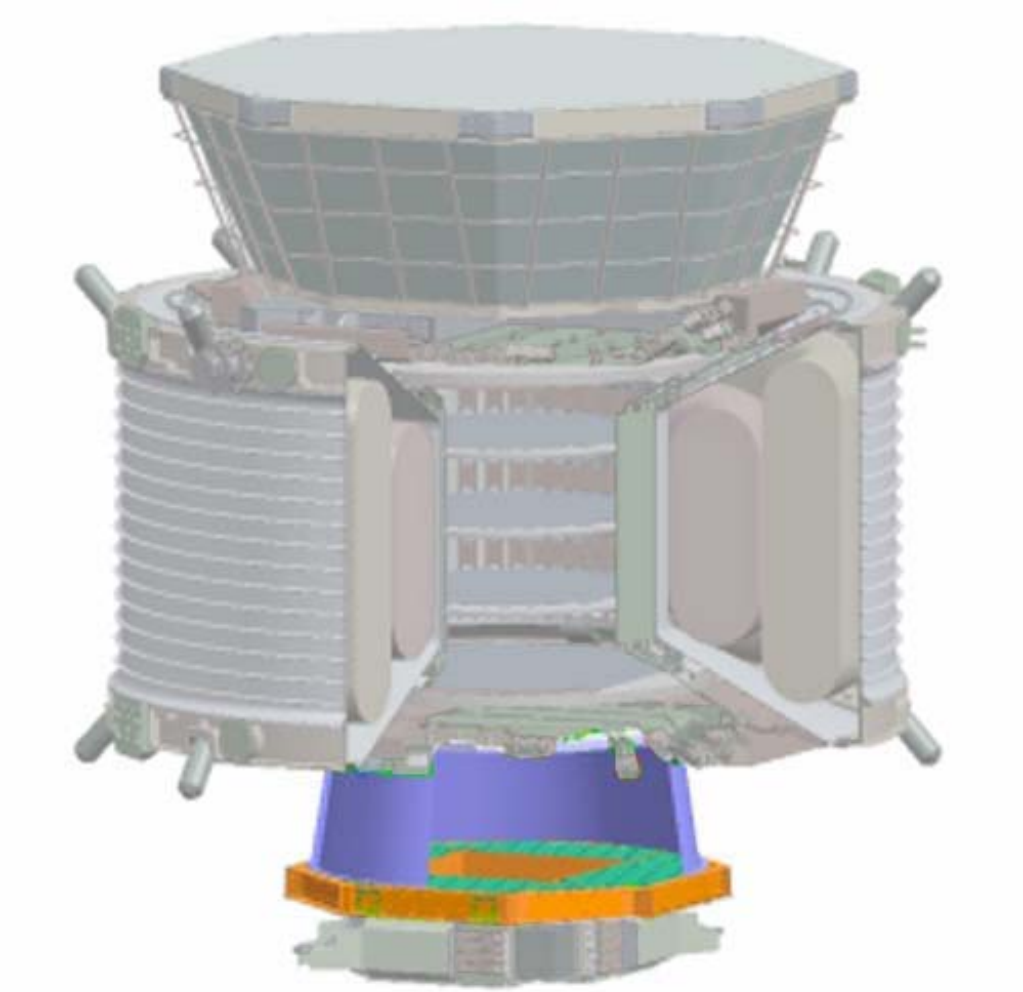


Tracker Silicon & Hybrids



Tracker Support Structure


a) AMS-02 Tracker Alignment System
basic components
M-crate
LCTL
(Laser control box)
LDDR #m
Laser Diode DriveR:
LDDR #m+1
rep. rate < 2000Hz,
amplitude < 200 mA,
width < 5000 ns
coaxial cable
LFCR #n
Laser Fibre CoupleR
laser diode
LFCR #n+1
laser diode
LFIB's monomode fibres
b) AMS-02 Si-tracker &
laser alignment rays
FC connection
support
structure
plate 1
plate 2
plate 3
plate 4
plate 5
Si ladders
installed on CFC plates
alignment rays
LBBX #k
(beam port box)
x [mm]
z [mm]
y [mm]
c) AMS-02 Si-sensor
for particles and alignment rays
110 µm
readout strip
spacing (⊥B)
high transparency
area (AR coated)



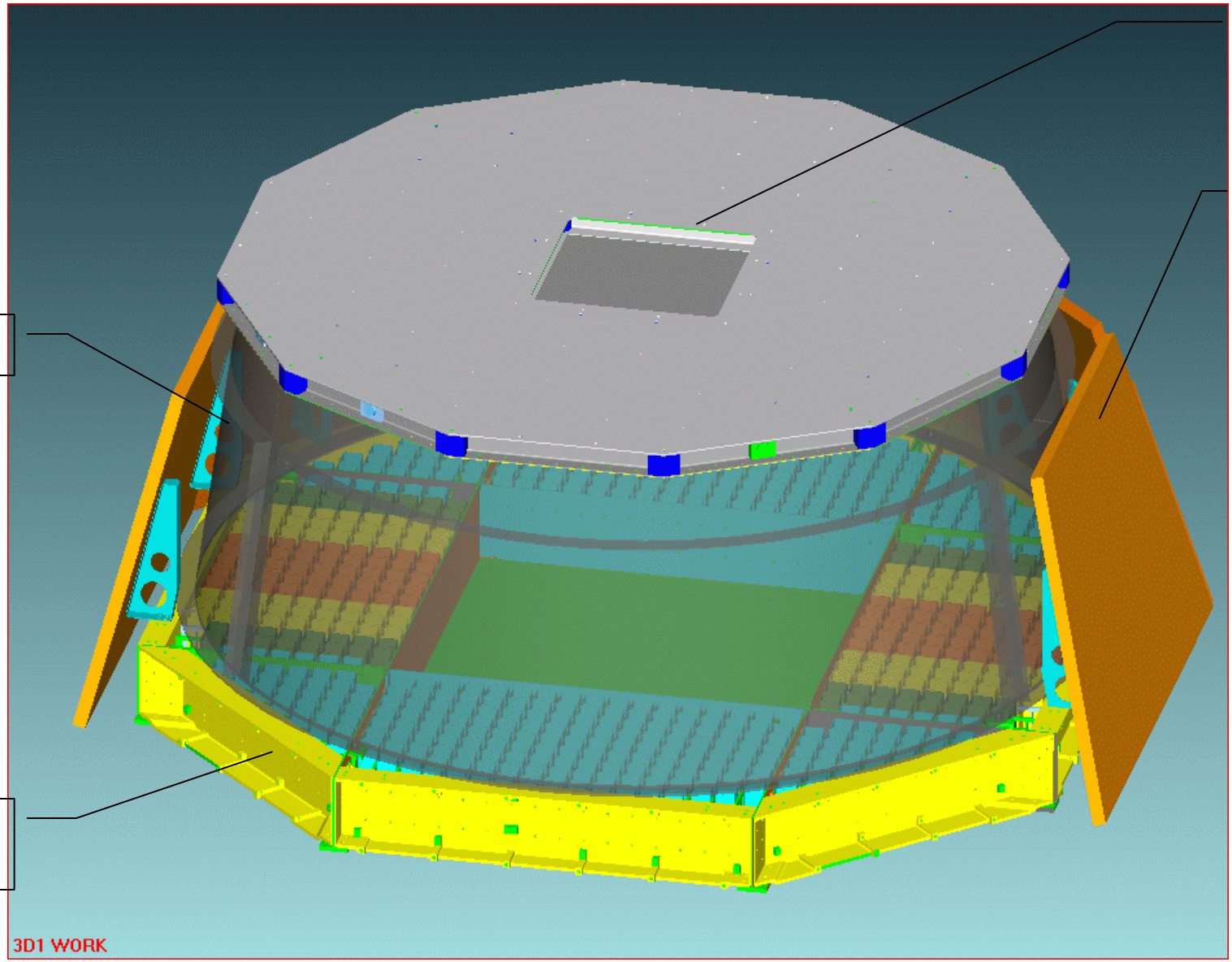
Ring Imaging Cherenkov Counter (RICH)

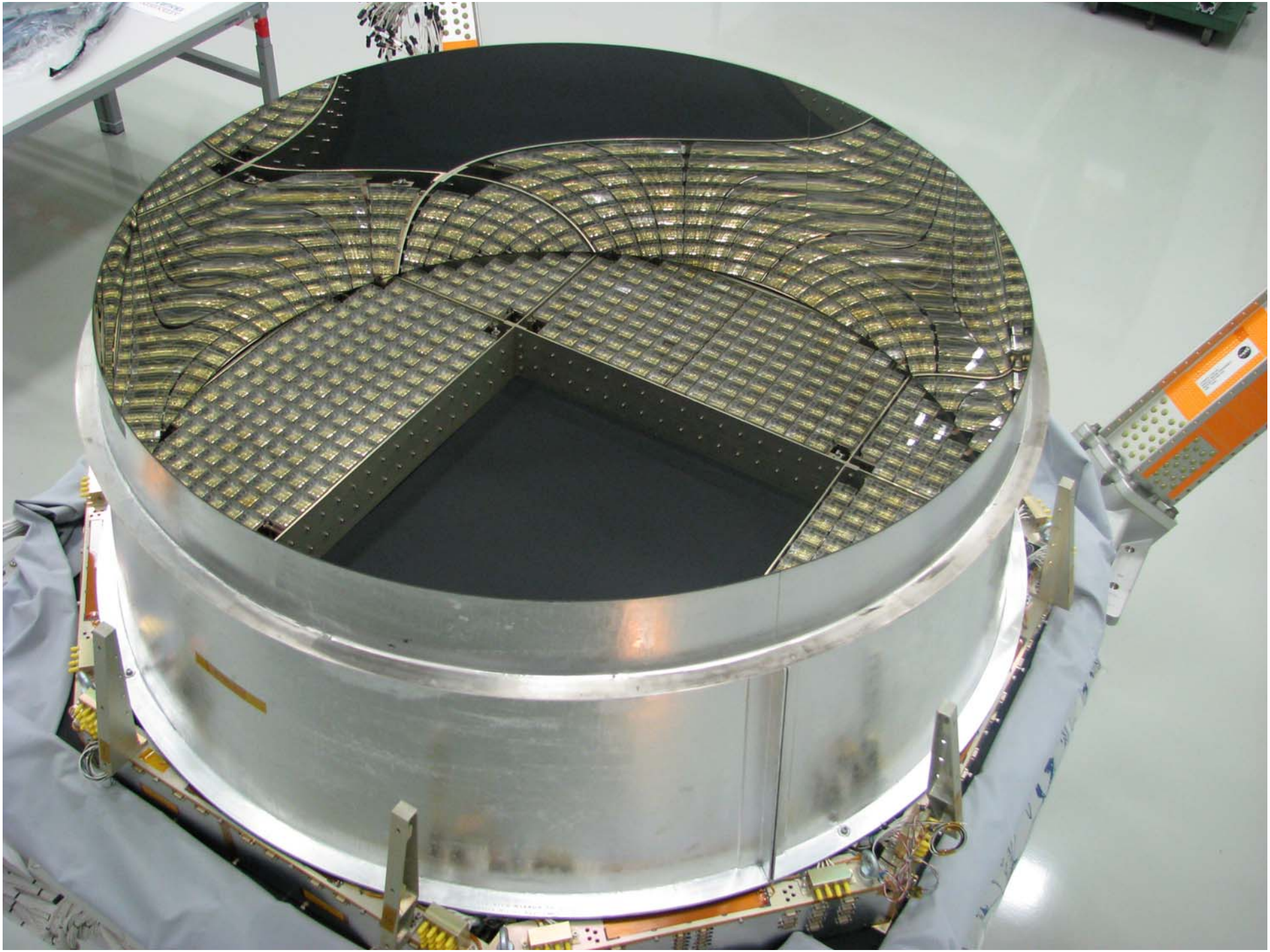
RICH

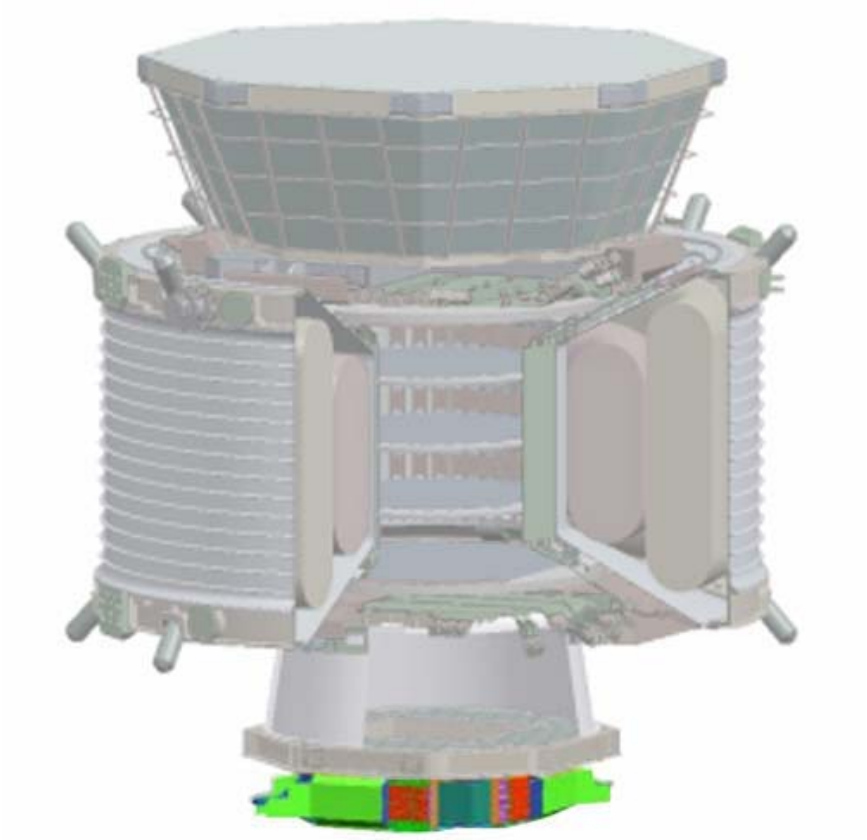
- Description
  - RICH measures particle charge magnitude and velocity magnitude to a high degree of accuracy
  - RICH is located near the bottom of the experiment stack
  - Approximately 140 x 140 x 57 cm
  - Al. 7075 T7351 for mechanical parts
  - Reflector - CFC K1352U/EX-1515
  - Radiator – Silica Aerogel and Sodium Fluoride
  - 680 Photomultipliers – Hamamatsu R7600 M16

Carlo Gavazzi Space SpA

RICH assembly



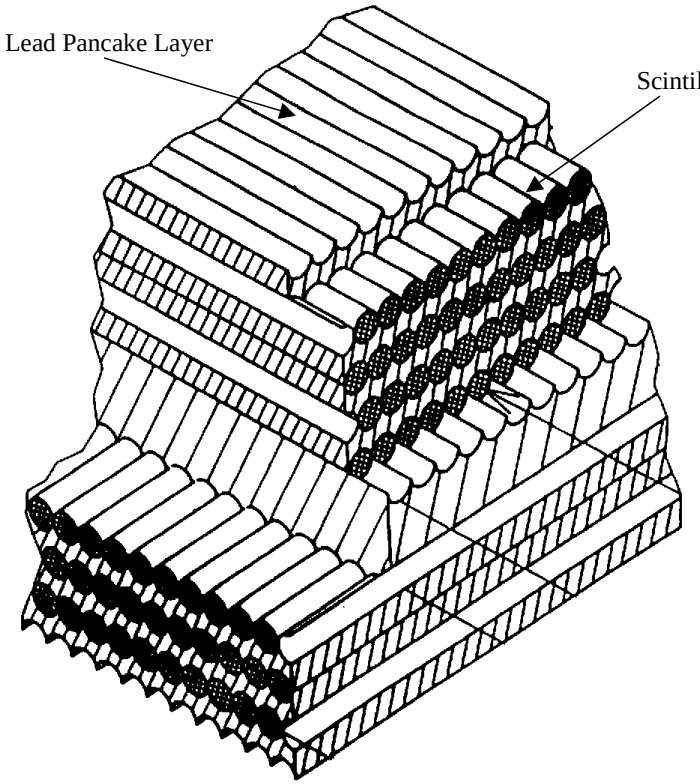


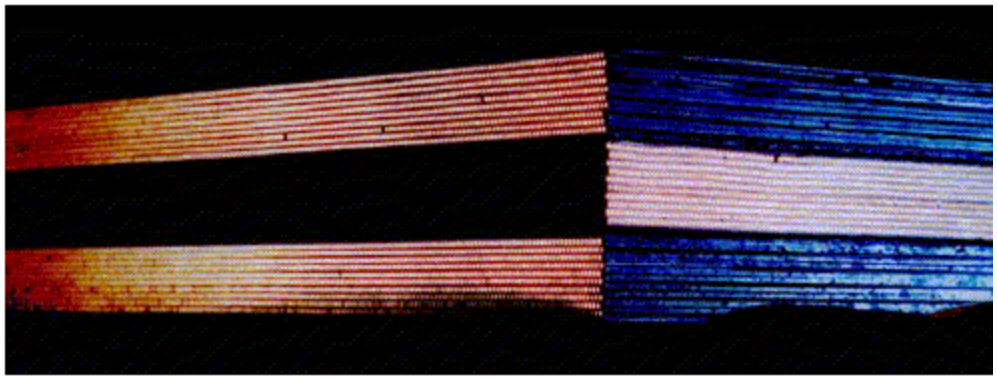


Electromagnetic Calorimeter (ECAL)

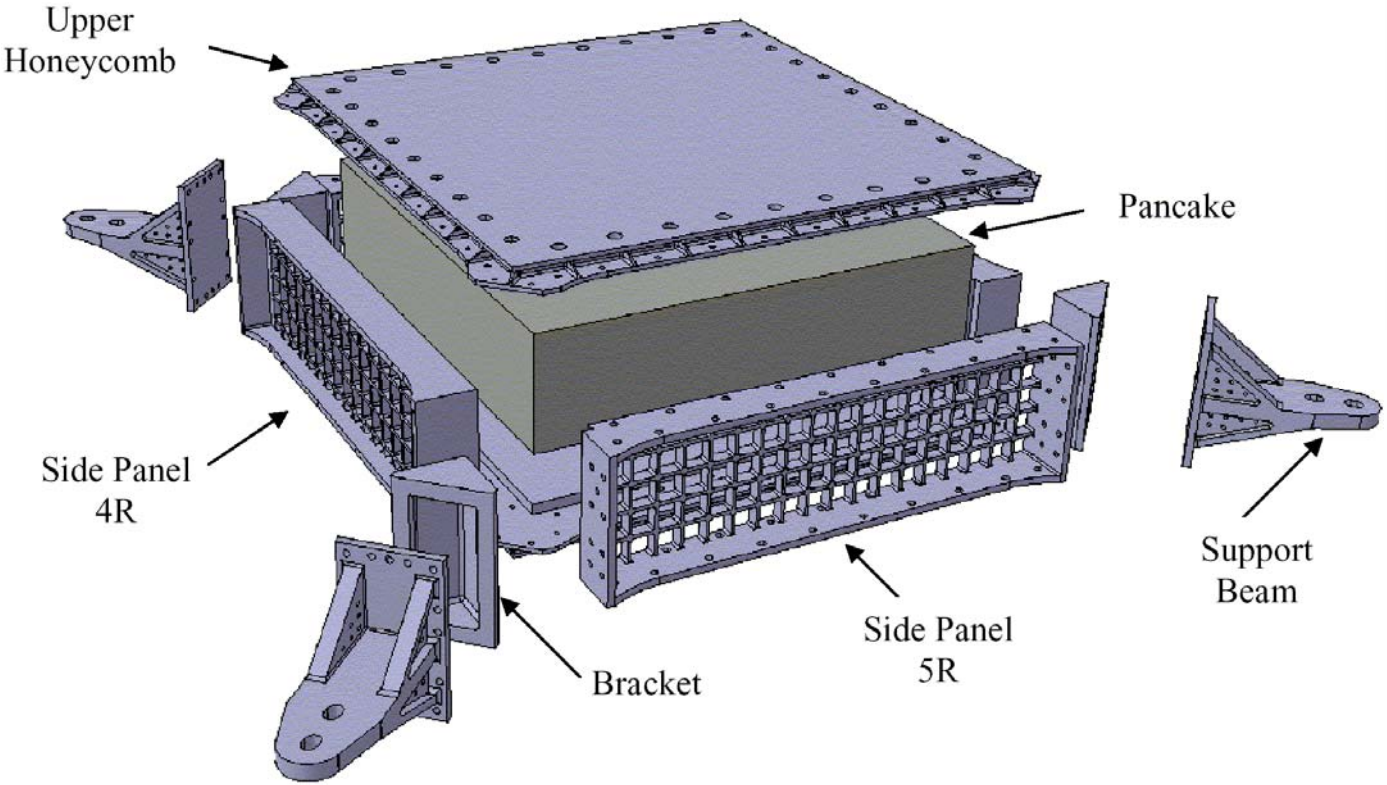
Electromagnetic Calorimeter (ECAL)

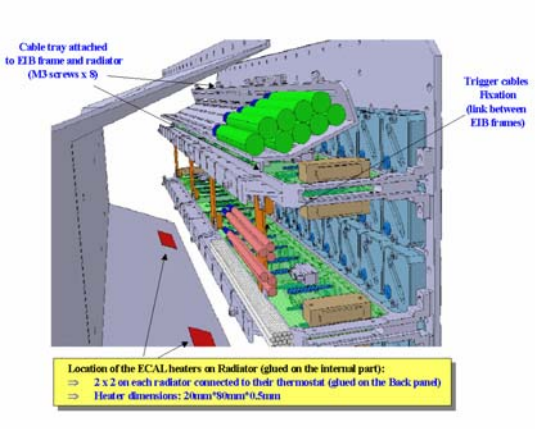
- ECAL measure particle energy
- Size, Location, and Description
  - ECAL is located at the bottom of the experiment stack
  - 658 X 658 X 250 mm
  - Mounts at 4 attach locations to USS-02 (radially slotted holes)
  - Aluminum Housing & Brackets
  - Aluminum Honeycomb top and bottom plate
  - Lead Foil ‘pancake’ layers
  - Scintillating Fibers
  - BC 600 Epoxy
  - Surrounded by Photomultiplier Tubes

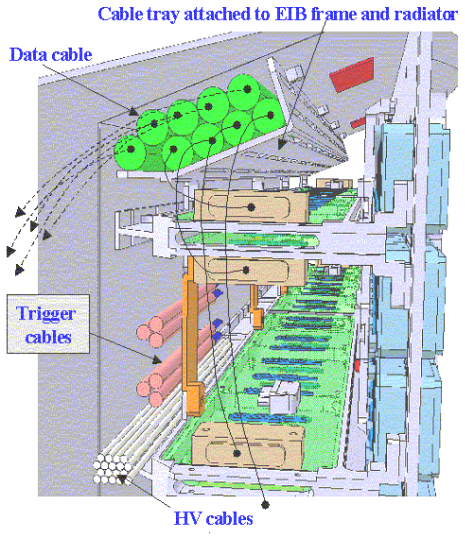

Lead Pancake Layer
Scintillating Fiber



Electromagnetic Calorimeter (ECAL)







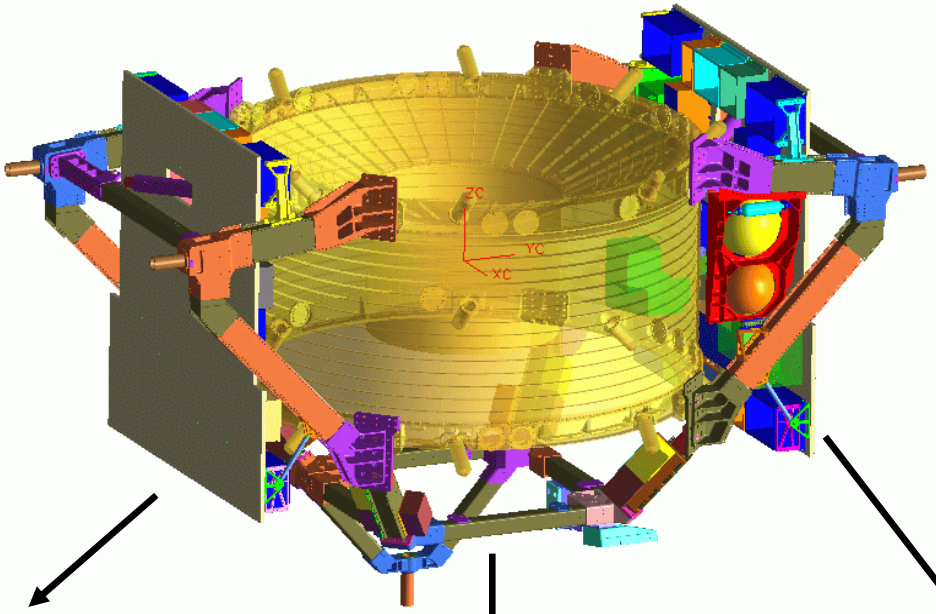
Electronic Crates

Electronics Crates

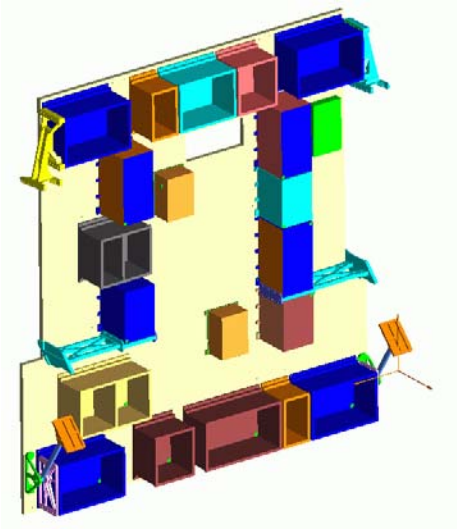
- Size, Location
  - 44 crates mounted at various points on the USS that form the support structure for the Ram & Wake Radiators
    - 24 crates are 195x293x(180-546) mm (8x12x(7-21) in)
    - 20 crates are 210x183x(145-295) mm (8x7x(6-12) in)
  - Altogether these crates contain ~600 printed circuit boards of 70 different designs
  - 7075-T7351 Series Aluminum alloy for electronic crate structures
  - Solithane 113 for Conformal Coating
  - XL-ETFE insulated cables

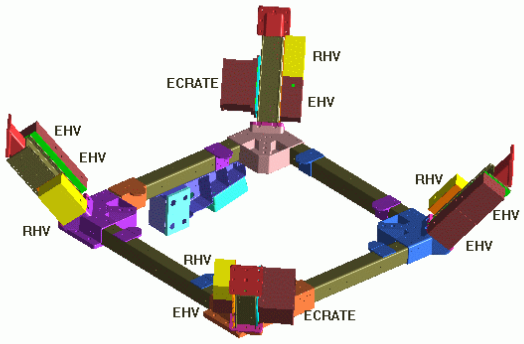
Electronic Crates

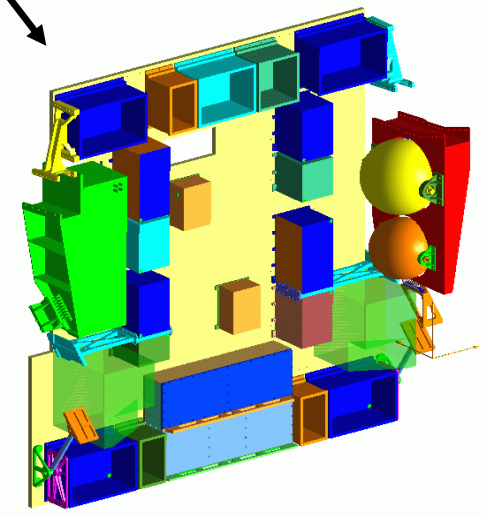
Ram Radiator and Electronic Crates



Wake Radiator and Electronic Crates

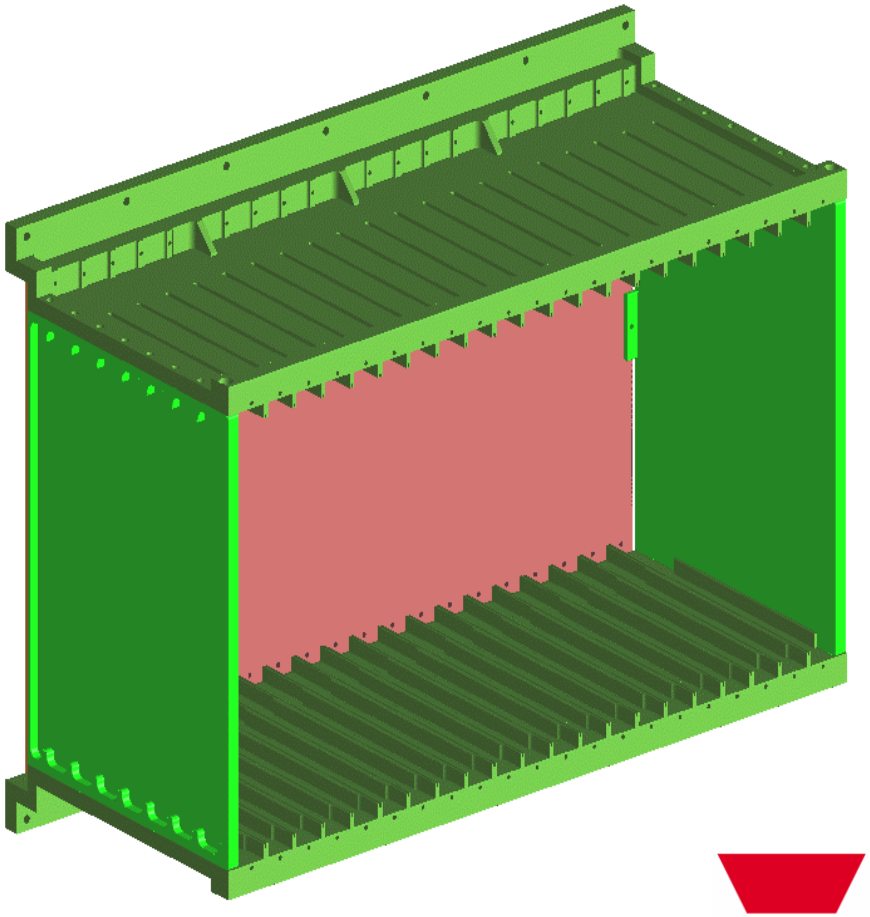


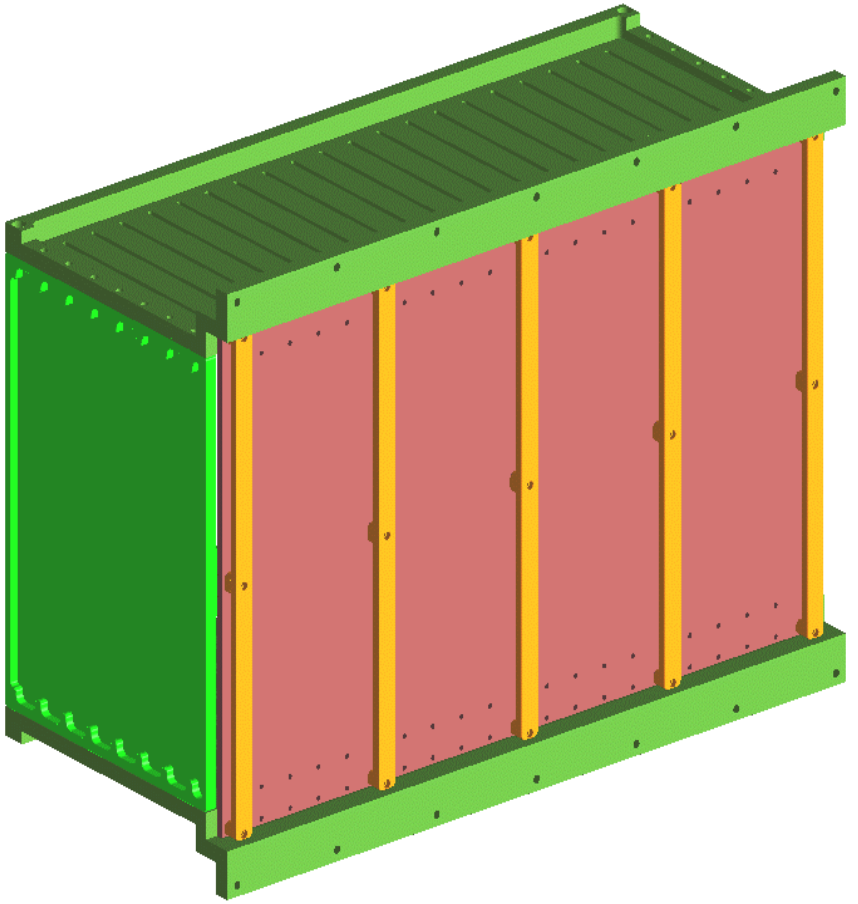




ECAL and RICH Electronic Crates

Electronics Crates

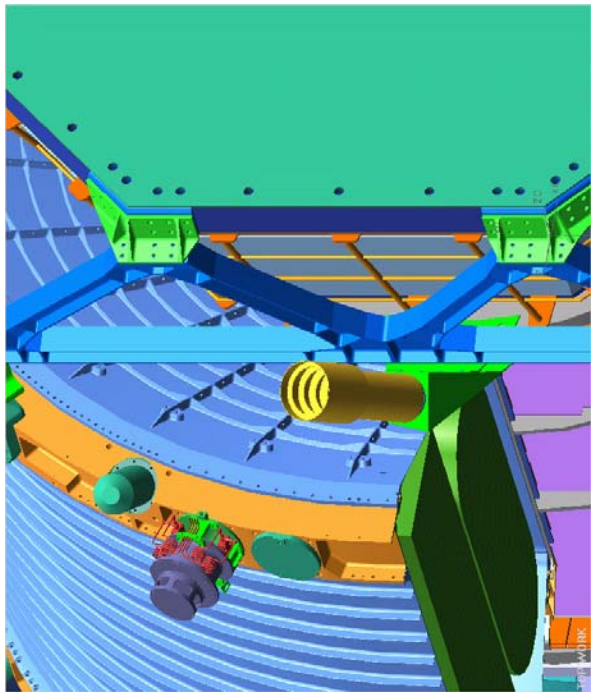


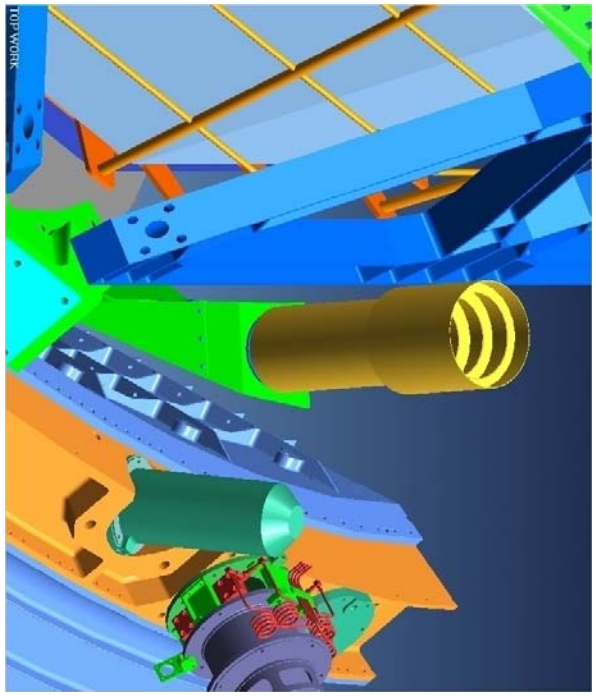


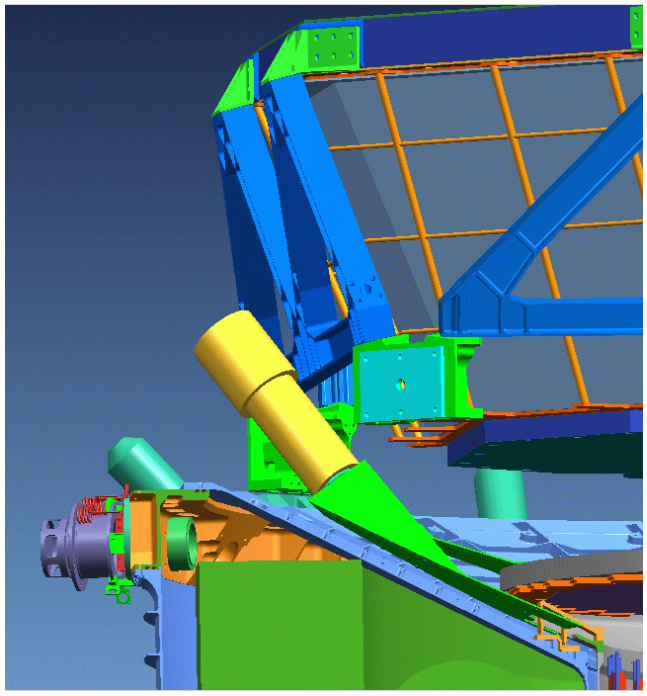
Star Tracker

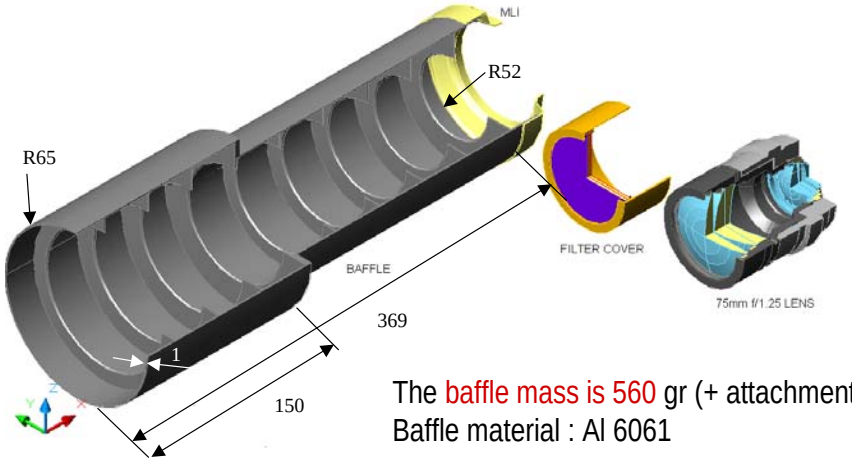
- 2 small subcomponents mounted to upper Tracker Plane and Conical Flange
- Total Weight = 3.3x2 Kg (15 lbs)
- Sharp Edge issue for baffle

Star Tracker

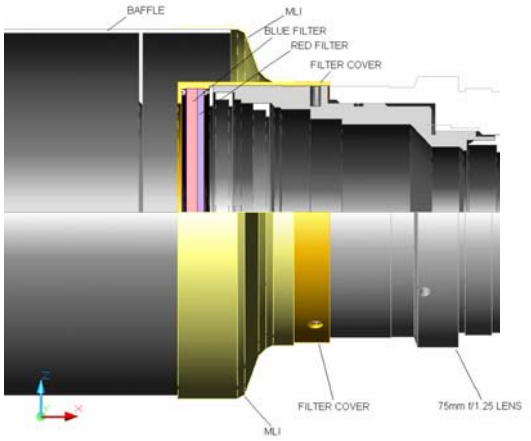


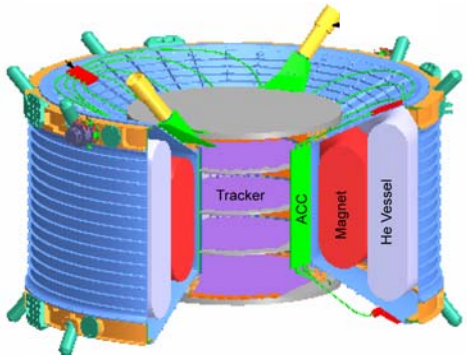






The baffle mass is 560 gr (+ attachment)
Baffle material : Al 6061





Thermal Control System

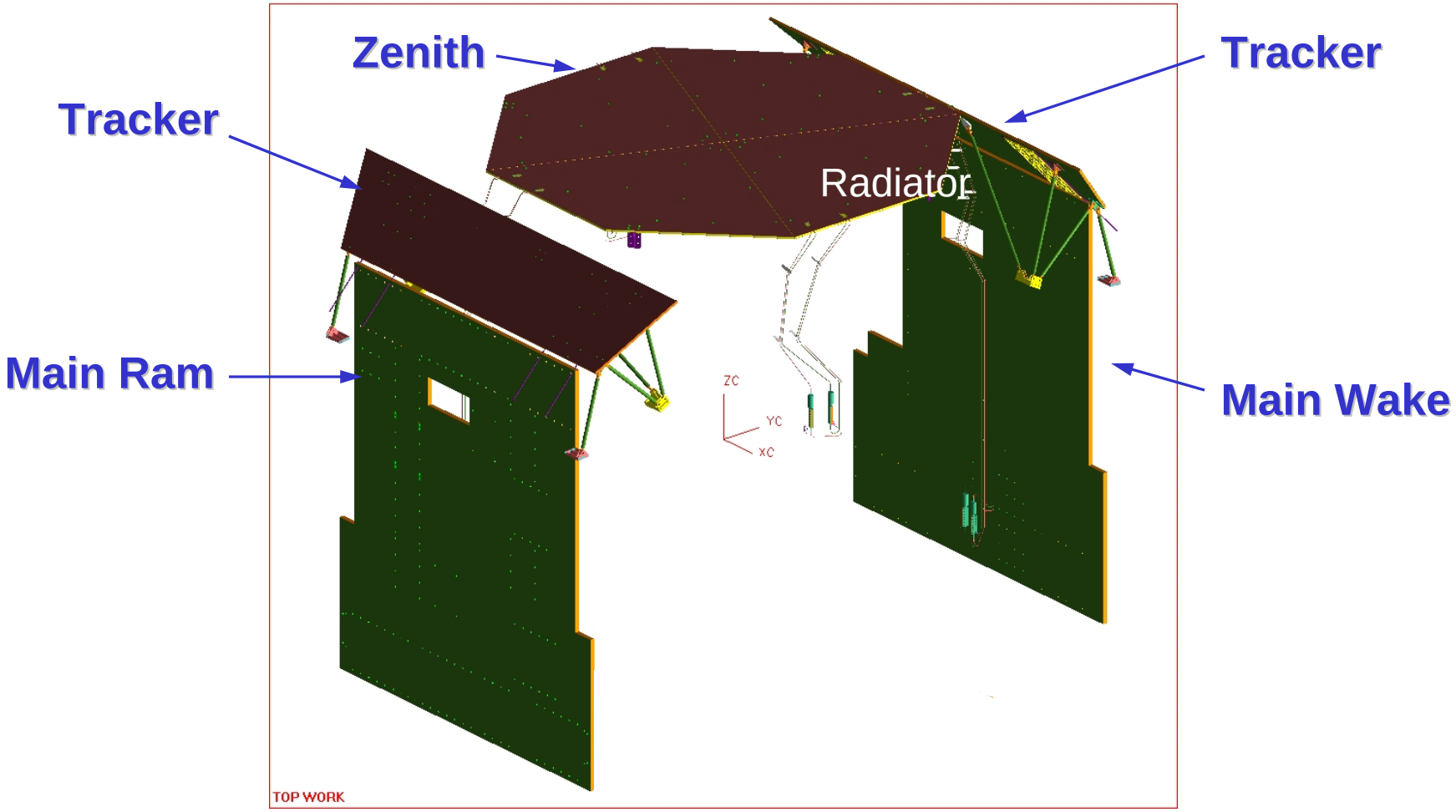
Thermal Control System

- Radiator Systems
  - Ram/Wake Radiators
  - Zenith (Cryocooler) Radiator
  - Tracker Ram/Wake Radiators
- Tracker Thermal Control System (TTCS)

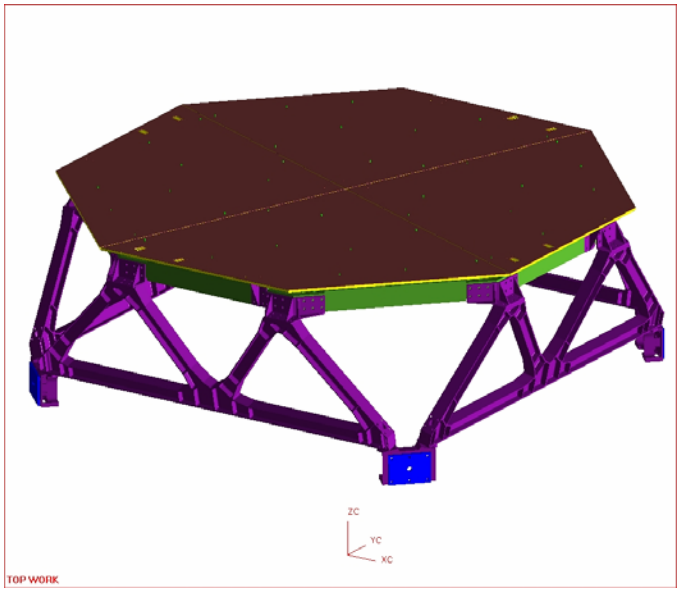
Thermal Control System

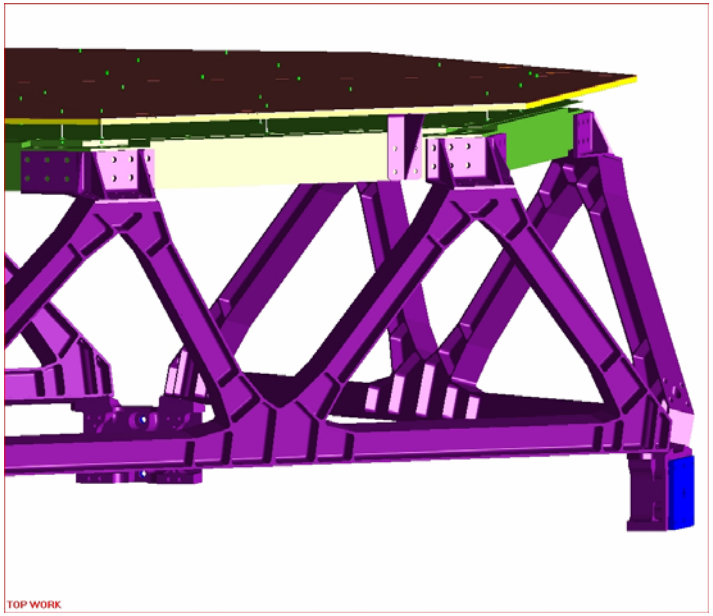
- Ram & Wake Radiator System
  - Aluminum Honeycomb
  - Electronic Crates provide stiffness to large flat plates
  - Aluminum Heat Pipes filled with Ammonia
    - Small amounts of Ammonia needed
    - Completely sealed system
- Fixation to USS-02
  - Fixed at upper USS-02 via Electronic Crates
  - Fixed in center of Radiator via mounting bracket
  - Pin Ended Strut to bottom of radiator via Electronic Crates

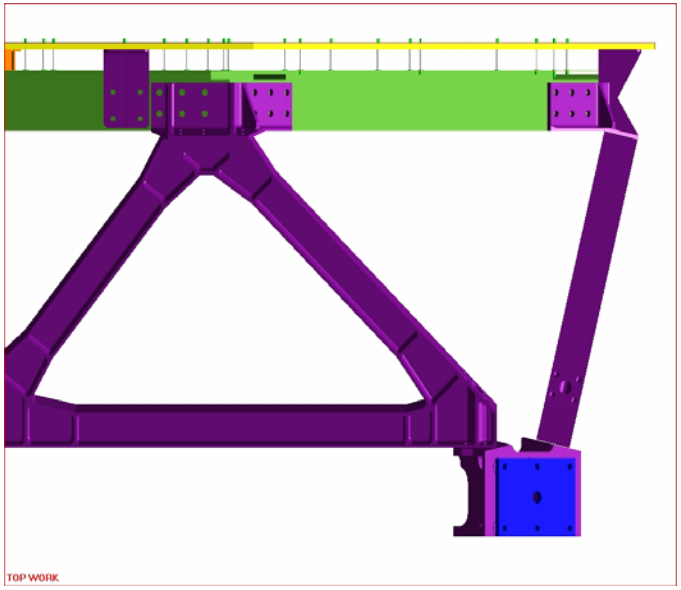
Thermal Control System



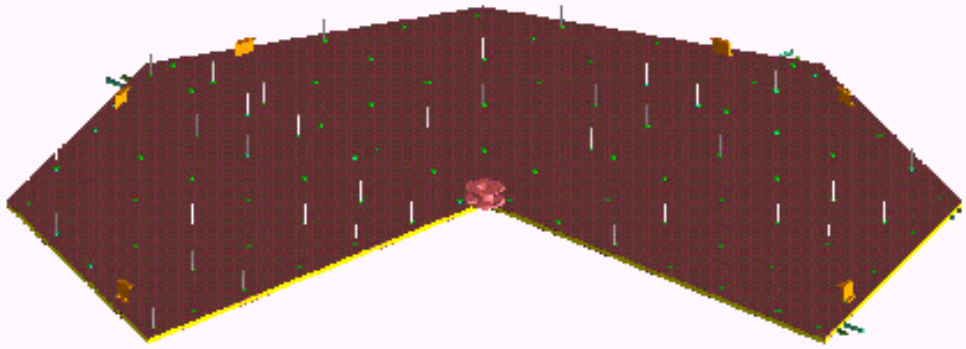
Zenith Radiator for Cryocoolers







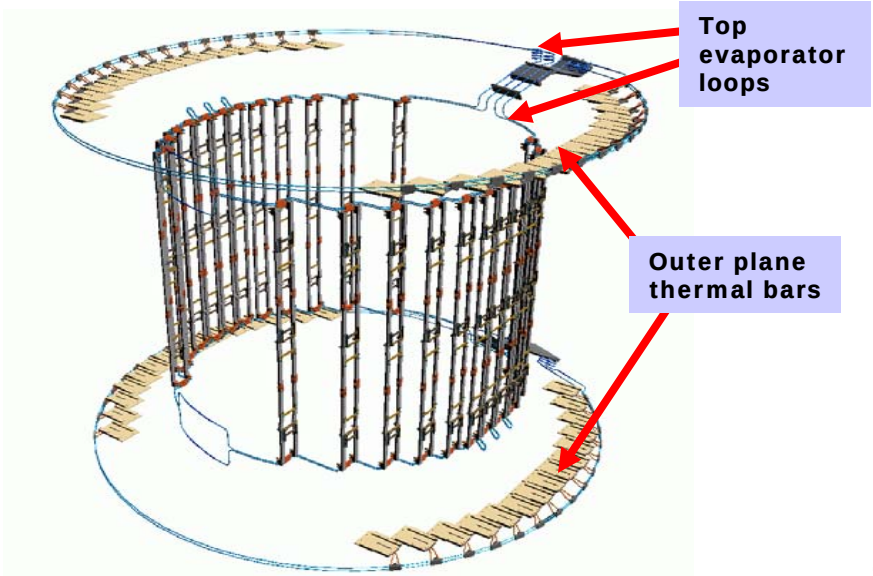
Radiator with one section removed

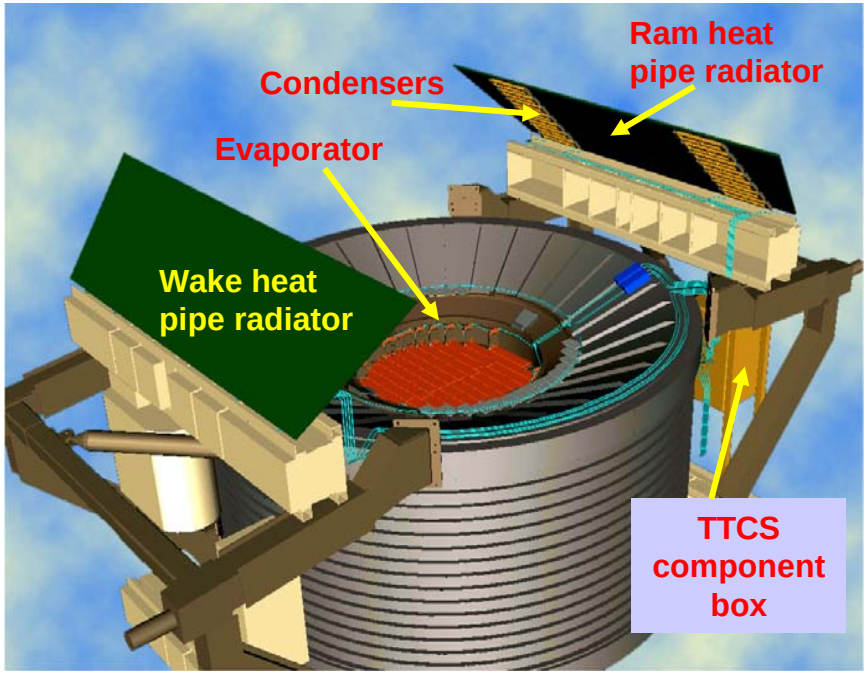


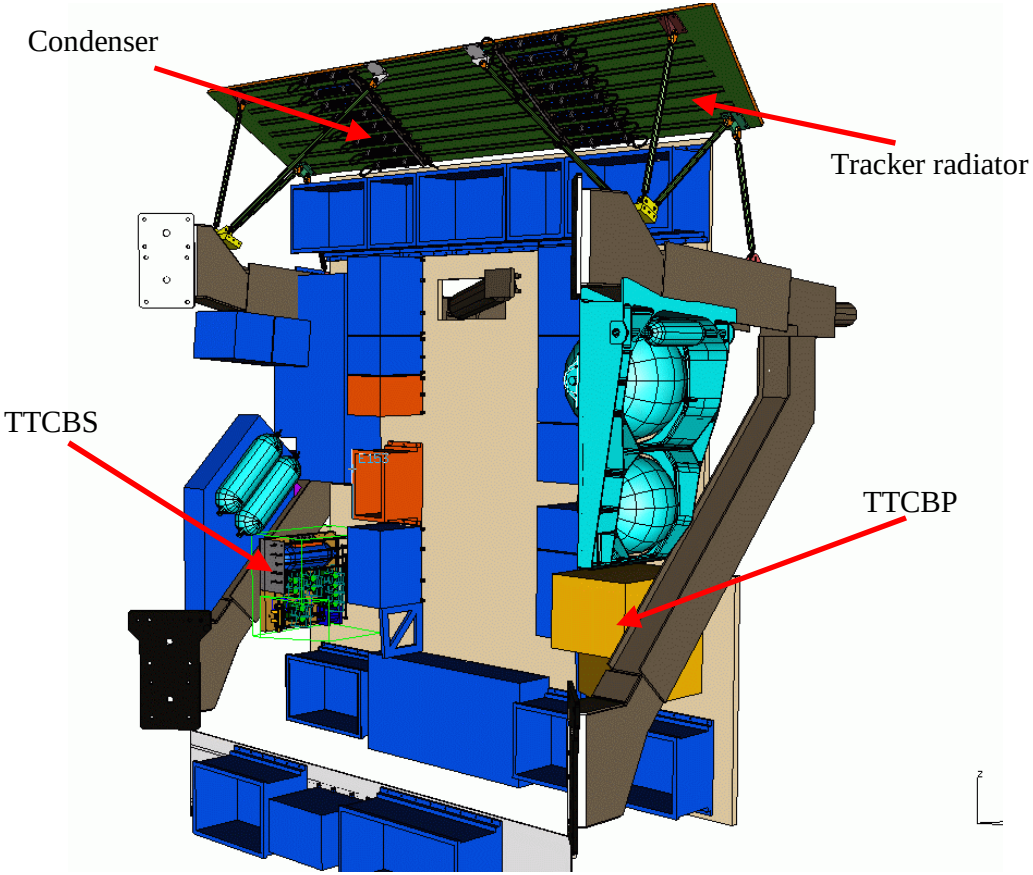
Thermal Control System

- Zenith Radiator
  - Propylene filled heat pipes
  - Rohacell foam sandwich panel
  - Aluminum tubes (3 mm OD, 2 mm ID)
  - Tubes soldered to upper face sheet
  - Bimetallic interface where aluminum tubes transition to stainless steel tubes before running down the structure and attaching to the Cryocoolers
  - Supported in the Z direction by 10 thermally isolating spokes on each quadrant that are 3 mm diameter and 35 mm long
  - Also supported by 2 aluminum brackets – 1 fixed in all directions & located at edge – 1 in center fixed in tangential direction (relative to outer support) & flexible in radial direction

TTCS


Top evaporator loops
Outer plane thermal bars


Ram heat pipe radiator
Condensers
Evaporator
Wake heat pipe radiator
TTCS component box


Condenser
Tracker radiator
TTCBS
TTCBP

Lower Unique Support Structure Integration